MANUAL UPDATES

The enclosed is updated material for the System Maintenance Manual, Number 9023.400, for the CS-8952 Field Deployable X-ray System.

These pages contain information on the new shipping fixtures, update the generator calibration procedure using non-invasive meters, and contain additional drawings on the table.

INSTRUCTIONS:

Each manual consists of two 3-1/2" wide gray 3-ring binders, labeled "Volume I" and "Volume II".

1. Each system was shipped with two sets of manuals. Locate both sets. The shrink-wrapped package contains material for updating both sets of manuals.

2. The enclosed pages replace three chapters in the manual:

   in Volume 1, Chapter 2 - Installation
   in Volume 1, Chapter 3 - Calibration
   in Volume 2, Chapter 7 - Table.

   The chapters are separated by colored pages. Each page is labeled with its chapter name on the bottom of the page.

3. Replace all of Chapter 2 with the new pages.

4. In Chapter 3, Calibration, locate the 22 x 33" multi-fold "Test Pattern", page 5-25. This will become FIGURE 5-3, Page 5-7.

   Position the enclosed pressure-sensitive label over the figure and page number on the drawing to correct the designation. Insert the corrected "Test Pattern" at page 5-7 in the new chapter.

   Replace Chapter 3 with the new pages.

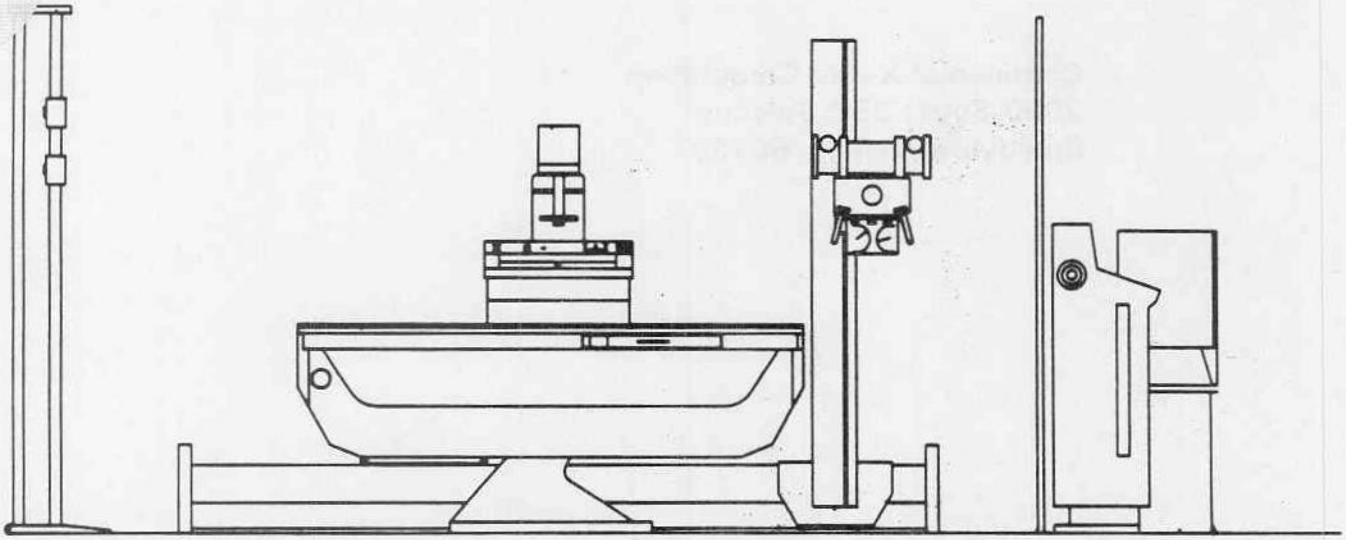
5. Replace all of Chapter 7 with the new pages.

CS-8952 FIELD DEPLOYABLE X-RAY SYSTEM

SYSTEM MAINTENANCE MANUAL 9023.400

updated April 1992

VOLUME I



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ORGANIZATION OF CHAPTERS

VOLUME I

CHAPTER 1 - GENERAL

CHAPTER 2 - INSTALLATION

CHAPTER 3 - CALIBRATION

CHAPTER 4 - TROUBLESHOOTING

CHAPTER 5 - OPERATION

CHAPTER 6 - MXT-350 GENERATOR

VOLUME II

CHAPTER 7 - MXT-90/15 TABLE

CHAPTER 8 - TUBESTAND

CHAPTER 9 - AUXILIARY BOX

CHAPTER 10 - SPOT FILM DEVICE

CHAPTER 11 - UNDER-TABLE COLLIMATOR

CHAPTER 12 - OVER-TABLE COLLIMATOR

CHAPTER 13 - AUTOMATIC EXPOSURE CONTROL

CHAPTER 14 - IMAGE INTENSIFIER

CHAPTER 15 - X-RAY TUBES

CHAPTER 16 - MISCELLANEOUS

TABLE OF CONTENTS

VOLUME I

SECTION PAGE

CHAPTER 1 - GENERAL

1 INTRODUCTION 1-1
1.1 HOW TO USE THIS MANUAL 1-1
1.2 SCOPE 1-1
1.3 SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES . . . 1-2
1.4 MAXIMUM PERMISSIBLE DOSE 1-3
1.5 CDRH COMPLIANCE 1-3

2 SPECIFICATIONS 2-1
2.1 GENERATOR SPECIFICATIONS 2-1
2.2 TABLE SPECIFICATIONS 2-3
2.3 TUBESTAND SPECIFICATIONS 2-4

3 STORAGE 3-1
3.1 GENERAL 3-1
3.2 LUBRICATION SPECIFICATIONS 3-1
3.3 STORAGE INFORMATION OF SPOT FILM DEVICE 3-2
3.4 STORAGE INFORMATION
OF THE IMAGE INTENSIFIER SYSTEM 3-2

CHAPTER 2 - INSTALLATION

1 GENERAL 1-1
1.1 SCOPE 1-1
1.2 TOOLS REQUIRED 1-1
1.3 EQUIPMENT REQUIRED 1-1
1.4 TRANSPORTATION 1-1
1.5 UNPACKING 1-5
1.6 DIRECTIONAL ASSIGNMENT NAMING CONVENTION USED 1-6
1.7 TRANSPORT DEVICE 1-7
1.8 MOVING THE TUBESTAND 1-10
1.8.1 MOUNTING THE TUBESTAND 1-10
1.9 MOVING THE TABLE 1-16
1.9.1 TABLE MOUNTING 1-18
1.9.2 TABLE TOP REMOVAL AND SETUP 1-23
1.9.3 FRONT COUNTERWEIGHT INSTALLATION 1-25
1.9.4 REAR COUNTERWEIGHT INSTALLATION 1-25
1.10 RADIATION SHIELD 1-29

TABLE OF CONTENTS

VOLUME I

SECTION PAGE

CHAPTER 2 - INSTALLATION (continued)

1.11 MOVING GENERATOR COMPONENTS 1-31
1.11.1 MOUNTING GENERATOR 1-34
1.12 UNPACKING AND MOUNTING THE UNDER-TABLE COLLIMATOR AND X-RAY TUBE 1-38
1.13 UNPACKING AND MOUNTING THE SPOT FILM DEVICE AND IMAGE INTENSIFIER 1-38
1.14 ELECTRICAL CONNECTIONS 1-43
1.15 OVER-TABLE COLLIMATOR AND X-RAY TUBE INSTALLATION 1-43
1.15.1 OVER-TABLE X-RAY TUBE INSTALLATION 1-43
1.15.2 OVER-TABLE COLLIMATOR INSTALLATION 1-47
1.16 LEVELING THE TABLE AND PLUMBING THE TOWER 1-48
1.17 TABLE OPERATIONAL CHECK 1-49

2 TRANSPORT DEVICE PARTS LIST 2-1

CHAPTER 3 - CALIBRATION

1 GENERAL 1-1
1.1 SCOPE 1-1
1.2 TOOLS AND MATERIAL REQUIRED 1-1
1.3 TEST EQUIPMENT REQUIRED 1-2
1.4 INSTALLATION OF TEST EQUIPMENT WITH A DYNALYZER 1-3
1.4.1 INSTALLATION OF TEST EQUIPMENT WITH NONINVASIVE METERS 1-3
1.5 WARM UP PROCEDURE 1-4

2 MXR-350 GENERATOR 2-1
2.1 INTRODUCTION 2-1
2.2 50/60 HZ CONVERSION 2-4
2.3 LINE COMPENSATION 2-9
2.4 KVP COMPENSATION 2-11
2.4.1 DETERMINATION OF LINE DROP 2-11
2.4.2 KVP COMPENSATION USING DYNALYZER 2-15
2.4.3 KVP COMPENSATION WITH NONINVASIVE KVP METER 2-20
2.5 ROTOR ADJUSTMENT (BOOST TIME) 2-25
2.6 TUBE OVERLOAD ADJUSTMENTS (TOLA) 2-31
2.7 RADIOGRAPHIC TIMER (50HZ AND 60HZ) VERIFICATION 2-31
2.7.1 60 HZ RADIOGRAPHIC TIMER CALIBRATION 2-33

TABLE OF CONTENTS

VOLUME I

SECTION PAGE

CHAPTER 3 - CALIBRATION (continued)

2.7.2 50 HZ RADIOGRAPHIC TIMER CALIBRATION 2-38
2.8 BACK-UP TIMER (50 HZ AND 60 HZ) VERIFICATION 2-39
2.8.1 60 HZ BACK UP TIMER CALIBRATION 2-40
2.8.2 50 HZ BACK UP TIMER CALIBRATION 2-45
2.9 MA FILAMENT (OVER-TABLE X-RAY TUBE) USING DYNALYZER 2-46
2.9.1 MA FILAMENT USING NONINVASIVE METERS (OVER-TABLE X-RAY TUBE) 2-50
2.10 SPACE CHARGE COMPENSATION 2-53
2.11 UNDER-TABLE TUBE CALIBRATION 2-56
2.12 MA FILAMENT (UNDER-TABLE X-RAY TUBE) 2-56
2.13 SPACE CHARGE COMPENSATION (UNDER-TABLE X-RAY TUBE) 2-57
2.14 SPOT FILM PREHEAT 2-57
2.15 FLUOROSCOPIC KVP 2-58
2.16 FLUOROSCOPIC MA USING DYNALYZER 2-59
2.16.1 FLUOROSCOPIC MA USING NONINVASIVE METERS 2-60
2.17 EXPOSURE MAS 2-65
2.18 END OF EXPOSURE SIGNAL 2-65

3 SPOT FILM DEVICE CALIBRATION 3-1

4 UNDER-TABLE COLLIMATOR CALIBRATION 4-1
4.1 SCOPE 4-1
4.2 GENERAL DESCRIPTION 4-1
4.3 SERVICE ADJUSTMENTS, CONTROLS & INDICATORS 4-3
4.3.2 TEST POINTS AND FUNCTION 4-3
4.3.3 ANALOG VOLTAGE CHANNEL SWITCH 4-5
4.3.4 CALIBRATION/MODE SWITCH AND ALPHANUMERIC DISPLAY 4-7
4.3.5 SID RATIO AND CALIBRATION SWITCH 4-12
4.3.6 RESET SWITCH 4-13
4.3.7 WATCHDOG TIMER SHUNT 4-13
4.3.8 +5 VOLT A/D REFERENCE ADJUSTMENT 4-13
4.3.9 SPOT-FILM REFERENCE VOLTAGE ADJUSTMENT 4-13
4.3.10 COLLIMATOR POTENTIOMETER REFERENCE (VCP) ADJUSTMENT 4-14
4.3.11 CONTINUOUS SID MONITOR ADJUSTMENTS 4-14
4.3.12 COLLIMATOR SHUTTER CALIBRATION ADJUSTMENTS 4-14

TABLE OF CONTENTS

VOLUME I

SECTION PAGE

CHAPTER 3 - CALIBRATION (continued)

4.3.12.1 SHUTTER DRIVE INDICATORS 4-15
4.3.13 +5.0 VOLT A/D REFERENCE CALIBRATION 4-15
4.3.14 SPOT-FILM REFERENCE VOLTAGE CALIBRATION 4-15
4.3.15 COLLIMATOR HEAD REFERENCE VOLTAGE CALIBRATION .. 4-15
4.3.16 CONTINUOUS SID ADJUSTMENT 4-16
4.3.17 COLLIMATOR SHUTTER CALIBRATION 4-17
4.3.17.1 DESCRIPTION 4-17
4.3.17.2 COLLIMATOR SHUTTER ACCESS 4-17
4.3.17.3 SHUTTER OFFSET ADJUSTMENT 4-17
4.3.17.4 SHUTTER GAIN ADJUSTMENT 4-18
4.3.17.5 RE-ASSEMBLY 4-19
4.4 OPERATIONAL CHECKOUT PROCEDURE 4-20
4.4.1 DESCRIPTION 4-20
4.4.2 COLLIMATOR CENTERING ALIGNMENT 4-20
4.4.3 FLUOROSCOPIC IMAGE SIZE (I.I.) ADJUSTMENT 4-23
4.4.4 1-ON-1 (FULL) RADIOGRAPHIC FILM ADJUSTMENT 4-23
4.4.5 2-ON-1 LONGITUDINAL RADIOGRAPHIC FILM ADJUST 4-24
4.4.6 2-ON-1 TRANSVERSE RADIOGRAPHIC FILM ADJUST 4-24
4.4.7 3-ON-1 RADIOGRAPHIC FILM ADJUSTMENT 4-25
4.4.8 4-ON-1 RADIOGRAPHIC FILM ADJUSTMENT 4-25
4.4.9 6-ON-1 RADIOGRAPHIC FILM ADJUSTMENT 4-26
4.4.10 9-ON-1 RADIOGRAPHIC FILM ADJUSTMENT 4-26
4.4.11 SID TRACKING VERIFICATION 4-26

5 OVER-TABLE COLLIMATOR CALIBRATION 5-1
5.1 OPERATIONAL CHECKOUT PROCEDURES - MODEL LINEAR II . 5-1
5.1.1 PRELIMINARY SETUP 5-1
5.1.2 COLLIMATOR TILT SWITCH CHECKOUT 5-3
5.1.3 TABLE TILT SWITCH CHECKOUT 5-3
5.1.4 LOGIC AND COLLIMATOR OPERATION CHECKOUT 5-5
5.1.5 TABLE RECEPTOR SID SIGNAL CHECKOUT 5-6
5.1.6 EXTERNAL IR SIGNALS CHECKOUT 5-7
5.1.7 INPUT SIGNAL VERIFICATION CHART 5-9
5.1.8 FINAL TEST SWITCH SETTINGS 5-9
5.2 ADJUSTMENT PROCEDURES 5-11
5.2.1 LIGHT FIELD/X-RAY CONGRUENCE TEST 5-13
5.2.2 40" SID ADJUSTMENT 5-15
5.2.3 COLLIMATOR FEEDBACK LINEARITY TEST 5-16
5.2.4 CASSETTE TRAY ADJUSTMENT 5-18

TABLE OF CONTENTS

VOLUME I

SECTION PAGE

CHAPTER 3 - CALIBRATION (continued)

5.3 ALIGNMENT PROCEDURES 5-19
5.3.1 FIELD PROJECTION LAMP AND MIRROR ADJUSTMENT 5-19
5.3.2 CROSS-HAIR WINDOW ADJUSTMENT 5-22
5.3.3 BUCKY CENTERING LIGHT-LINE ADJUSTMENT 5-23
5.3.4 COLLIMATOR POTENTIOMETER VOLTAGE ADJUSTMENT (VCPL, VCPC) 5-24
5.4 TEST PATTERN 5-25

6 AUTOMATIC EXPOSURE CONTROL CALIBRATION 6-1
6.1 FIELD CALIBRATION INSTRUCTIONS 6-1
6.2 PRELIMINARY STEPS 6-1
6.3 KVP LEVEL ADJUSTMENT 6-5
6.4 CHAMBER GAIN (MAIN DENSITY) ADJUSTMENT. 6-6
6.5 FIELD MATCHING 6-8
6.6 KVP COMPENSATION 6-9
6.7 CONCLUSION OF FIELD CALIBRATION 6-11

7 IMAGE INTENSIFIER CALIBRATION 7-1
7.1 IMAGE TUBE FOCUS 7-1

CHAPTER 4 - TROUBLESHOOTING

1 SUB-SYSTEM TROUBLESHOOTING 1-1
1.1 SCOPE 1-1
1.2 GENERATOR FAULT CONDITIONS 1-1
1.3 X-RAY TABLE FAULT CONDITIONS 1-3
1.4. TUBESTAND FAULT CONDITIONS 1-5
1.5 SPOT FILM DEVICE FAULT CONDITIONS 1-6
1.6 COLLIMATOR FAULT CONDITIONS 1-7
1.7 AUTOMATIC EXPOSURE CONTROL FAULT CONDITIONS 1-8
1.8 IMAGE INTENSIFIER FAULT CONDITIONS 1-9

2 SYSTEM WIRE LISTS 2-1
2.1 GLOSSARY OF ABBREVIATIONS 2-1
2.2 SYSTEM LEVEL WIRE LIST 2-4
2.3 SFD CABLES 2-33
2.4 ION CHAMBER CABLE 2-37
2.5 SID SW CABLE 2-38
2.6 COLLIMATOR LOGIC CABLE 2-39

TABLE OF CONTENTS

VOLUME I

SECTION PAGE

CHAPTER 5 - OPERATION

1 INTRODUCTION 1-1
1.1 GENERAL 1-1
1.2 SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES 1-1
1.3 MAXIMUM PERMISSIBLE DOSE 1-2
1.4 CDRH COMPLIANCE 1-2

2 CONTROLS AND INDICATORS 2-1
2.1 INTRODUCTION 2-1
2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS 2-1
2.2.1 FLUOROSCOPIC CONTROLS 2-1
2.2.2 RADIOGRAPHIC (X-RAY) CONTROLS 2-1
2.2.3 METERS 2-6
2.3 SPOT FILM DEVICE 2-7
2.4 TABLE CONTROLS 2-15
2.5 TUBESTAND AND RADIOGRAPHIC COLLIMATOR 2-17
2.6 IMAGING SYSTEM 2-20
2.7 SYSTEM ACCESSORIES 2-21

3 DAILY PRE-OPERATIONAL SYSTEM CHECK 3-1
3.1 INTRODUCTION 3-1
3.2 DAILY PRE-OPERATIONAL SYSTEM CHECK 3-1

4 OPERATING PROCEDURES 4-1
4.1 INTRODUCTION 4-1
4.2 POWER APPLICATION 4-1
4.3 RADIOGRAPHIC PROCEDURE 4-1
4.4 FLUOROSCOPIC PROCEDURE 4-2
4.5 FLUOROSCOPY WITH SPOT FILM PROCEDURE 4-4

5 BIOLOGICAL EFFECTS OF RADIATION 5-1
5.1 GENERAL 5-1

6 RADIOGRAPHIC TECHNIQUES FOR THE AVERAGE LABORATORY . . 6-1
6.1 INTRODUCTION 6-1
6.2 BASIC TECHNIQUES 6-1
6.3 USING THE TECHNIQUE CHART 6-1
6.4 SUPPLEMENTAL INFORMATION 6-3

7 OPERATOR MAINTENANCE 7-1
7.1 INTRODUCTION 7-1
7.2 SYSTEM INSPECTION 7-1

TABLE OF CONTENTS

VOLUME I

SECTION PAGE

CHAPTER 5 - OPERATION (continued)

8 SYSTEM CLEANING INSTRUCTIONS 8-1
8.1 GENERAL 8-1
8.2 IMAGE INTENSIFIER 8-1
8.3 TUBESTAND 8-1

9 STORAGE INFORMATION 9-1
9.1 GENERAL 9-1
9.2 STORAGE INFORMATION OF SPOT FILM DEVICE 9-1
9.3 STORAGE INFORMATION OF IMAGE INTENSIFIER SYSTEM 9-2

CHAPTER 6 MXT-350 GENERATOR

1 GENERATOR COMPONENTS 1-1
1.1 SCOPE 1-1
1.2 DESCRIPTION 1-1
1.2.1 MAIN CONTROL 1-1
1.2.2 PROTECTIVE CIRCUITS 1-4
1.2.3 HIGH VOLTAGE TRANSFORMER 1-4
1.3 SPECIFICATIONS 1-5
1.4 ADJUSTMENTS AND CALIBRATION 1-6

2 CIRCUIT DESCRIPTION 2-1
2.1 POWER CIRCUIT, CIRCUIT FUNCTION DESCRIPTION, CFD 1.0 2-1
2.2 HIGH VOLTAGE GENERATOR CIRCUIT, CFD 1.1 2-4
2.3 HIGH VOLTAGE GENERATOR INTERCONNECTIONS 2-6
2.4 CIRCUIT BREAKERS, CFD 1.2 2-7
2.5 LIGHT CIRCUIT, CFD 1.3 2-9
2.6 EXPOSURE CIRCUIT, CFD 2.0 2-11
2.7 MA OVERLOAD CIRCUIT, CFD 2.1 2-15
2.8 MA, TIME, & KVP OVERLOAD (TOLA) CIRCUIT, CFD 2.2 2-18
2.9 EXPOSURE END SIGNAL, CFD 2.4 2-21
2.10 EXPOSURE AND AUTOTIMER SAFETY CIRCUIT, CFD 2.6 2-23
2.11 FILAMENT CIRCUIT, CFD 3.0 2-25
2.12 SPACE CHARGE COMPENSATION, CFD 3.1 2-28
2.13 FILAMENT SELECTION, CFD 3.2 2-30
2.14 FILAMENT BOOST CIRCUIT, CFD 3.3 2-33
2.15 FLUORO RATE CONTROL, CFD 3.4 2-35
2.16 KVP METER CIRCUIT, CFD 4.0 2-38
2.16.1 RADIOGRAPHIC KVP 2-38

TABLE OF CONTENTS

VOLUME I

SECTION PAGE

CHAPTER 6 MXT-350 GENERATOR (continued)

2.16.2 FLUOROSCOPIC KVP 2-39
2.17 MA METER & SHUNT CIRCUIT, CFD 5.0 2-41
2.18 MAS METER CIRCUIT, CFD 5.1 2-45
2.19 SINGLE PHASE IMPULSE TIMER CIRCUIT, CFD 6.0 2-47
2.20 TIME SELECTOR SWITCH 2-51
2.21 BACK-UP TIMER, CFD 6.2 2-52
2.22 SINGLE PHASE SCR CONTACTOR CIRCUIT, CFD 6.3 2-55
2.23 ROTOR CONTROL CIRCUIT, CFD 7.0 2-57
2.24 SPOT FILM CHANGEOVER CIRCUIT, CFD 8.1 2-61
2.25 AUTOTIMER DENSITY SELECTION 2-65
2.26 AUTOTIMER & BACK-UP TIMER INTERLOCK 2-65
2.27 AUTOTIMER RESET AND FIELD SELECTOR, CFD 9.0 2-66
2.28 AUXILIARY RELAY CIRCUIT, CFD 9.3 2-68
2.29 AUTOTIMER TECHNIQUE SELECTOR, CFD 9.4 2-70

3 MAINTENANCE 3-1
3.1 INTRODUCTION 3-1
3.2 PREVENTIVE (PERIODIC) MAINTENANCE 3-1
3.2.1 LINE SET ADJUSTMENTS 3-1
3.2.2 NINETY (90) DAY INSPECTION 3-4
3.2.3 TWELVE (12) MONTH INSPECTION 3-5
3.2.4 OPERATIONAL TESTS 3-5
3.3 CORRECTIVE MAINTENANCE 3-6
3.3.1 GENERAL 3-6
3.3.2 HAND TOOLS REQUIRED 3-6
3.3.3 TEST EQUIPMENT 3-6
3.3.4 PARTS REPLACEMENT 3-7

4 MX-350 GENERATOR SIGNALS DESCRIPTION 4-1

5 PARTS LIST 5-1

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 7 - MXT-90/15 TABLE

1 GENERAL 1-1
1.1 SCOPE 1-1
1.2 TABLE DESCRIPTION 1-1
1.2.1 TABLE TOP 1-1
1.2.2 CARRIAGES AND TOWER 1-3
1.2.3 TABLE BODY 1-3
1.3 SPECIFICATIONS 1-3
1.4 ACCESSORIES 1-4
1.5 HAND TOOLS REQUIRED 1-5
1.6 TABLE OPERATION 1-5
1.7 ACCESSORY ATTACHMENT AND REMOVAL 1-5

2 CIRCUIT DESCRIPTION 2-1
2.1 INTRODUCTION 2-1
2.2 TABLE CIRCUIT DESCRIPTION 2-1
2.3 TABLE TOP DRIVE CONTROL 2-1
2.4 TABLE TILT CONTROL 2-3
2.5 MAGNETIC LOCK AND POWER ASSIST CIRCUITS 2-5
2.6 POWER DISTRIBUTION 2-5

3 MAINTENANCE 3-1
3.1 INTRODUCTION 3-1
3.2 GENERAL INSPECTION 3-1
3.3 COUNTERWEIGHT CABLE INSPECTION 3-2
3.4 OPERATIONAL CHECK 3-7
3.5 LOCK ADJUSTMENTS 3-9
3.5.1 TRANSVERSE AND COMPRESSION LOCK ADJUSTMENT 3-9
3.5.2 LONGITUDINAL AND GRID LOCK ADJUSTMENT 3-9
3.6 TILT DRIVE CHAIN TENSION ADJUSTMENT 3-10
3.7 CLEANING 3-10
3.8 LUBRICATION 3-10
3.9 CORRECTIVE MAINTENANCE 3-11
3.9.1 TABLE TOP REMOVAL AND REPLACEMENT 3-11

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 7 - MXT-90/15 TABLE (continued)

3.9.2 CABLE REPLACEMENT 3-13
3.9.2.1 UPPER VERTICAL CARRIAGE CABLE REPLACEMENT 3-13
3.9.2.2 FRONT COUNTERWEIGHT CABLE REPLACEMENT 3-13
3.9.2.3 REAR COUNTERWEIGHT CABLE REPLACEMENT 3-14
3.9.2.4 GRID CABINET COUNTERWEIGHT CABLE REPLACEMENT . . . 3-14
3.9.3 VERTICAL (COMPRESSION) LOCK 3-15
3.9.4 TRANSVERSE (FRONT-BACK) LOCK 3-15
3.9.5 LONGITUDINAL (HEAD-FOOT) AND GRID LOCKS 3-17
3.9.6 TILT DRIVE CHAIN REPLACEMENT 3-18

4 WIRING DIAGRAM AND PARTS LISTS 4-1

CHAPTER 8 - TUBESTAND

1 GENERAL 1-1
1.1 SCOPE 1-1
1.2 DESCRIPTION: 1-1
1.3 TUBESTAND SPECIFICATIONS 1-4

2 CIRCUIT DESCRIPTION 2-1
2.1 CIRCUIT DESCRIPTION 2-1
2.2 TUBESTAND CIRCUIT OPERATION 2-1
2.3 LOCK CONTROL CIRCUIT 2-1
2.4 FAN CIRCUIT 2-1
2.5 SID SWITCHES 2-2
2.6 COLLIMATOR CIRCUIT DESCRIPTION 2-4

3 MAINTENANCE 3-1
3.1 PREVENTIVE MAINTENANCE 3-1
3.1.1 ELECTRICAL LOCK FAILURE 3-2
3.1.2 STEEL CABLE REPLACEMENT 3-2
3.2 COLLIMATOR 3-2

4 PARTS LISTS 4-1

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 9 - AUXILIARY BOX

1 GENERAL 1-1
1.1 SCOPE 1-1
1.2 HIGH VOLTAGE CABLES 1-1
1.3 AUXILIARY BOX SIGNAL DESCRIPTION 1-3

2 WIRING DIAGRAM AND PARTS LISTS 2-1

CHAPTER 10 - SPOT FILM DEVICE

1.0 INTRODUCTION 1-1
1.1 FEATURES 1-2
1.1.1 SIMPLICITY 1-2
1.1.2 STANDARD FEATURES 1-2
1.1.3 ADVANCED FEATURES 1-2
1.2 SPECIFICATIONS 1-3

2.0 INSTALLATION 2-1
2.1 UNPACKING 2-2
2.2 STORAGE 2-2
2.3 EQUIPMENT SUPPLIED 2-3
2.4 MOUNTING ACCESSORY DEVICES 2-3
2.5 INTERCONNECTING WIRING 2-3
2.6 X-RAY GENERATOR WIRING 2-4

3.0 OPERATIONAL CHECKOUT PROCEDURE 3-1
3.1 OPERATIONAL CHECKLIST 3-2
3.2 POWER ASSIST CHECKOUT 3-3

4.0 CALIBRATION 4-1

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 10 - SPOT FILM DEVICE (continued)

5.0 OPERATION . . . 5-1
5.1 RADIATION PROTECTION . . . 5-2
5.2 MAXIMUM PERMISSIBLE DOSE . . . 5-3
5.3 MANUFACTURER'S RESPONSIBILITY . . . 5-3
5.4 MONITORING OF PERSONNEL . . . 5-5
5.5 PUSHBUTTON SWITCHES AND LED DISPLAY . . . 5-5
5.6 POWER ASSIST HANDLE . . . 5-9
5.7 MANUAL POSITIONING . . . 5-10
5.8 OPERATING PROCEDURES . . . 5-10
5.9 OPERATING DETAILS . . . 5-12
5.10 OPERATOR MAINTENANCE . . . 5-13
5.11 OPERATIONAL TESTS . . . 5-14
5.12 CLEANING . . . 5-14

6.0 COMPLIANCE VERIFICATION . . . 6-1
6.1 VERIFICATION TEST TO BE PERFORMED . . . 6-3
XR8-2.16 MINIMUM FIELD SIZE . . . 6-4
XR8-2.20 X-RAY FIELD LIMITATION AND ALIGNMENT . . . 6-6
XR8-2.24 FLUOROSCOPIC X-RAY FIELD LIMITATION . . . 6-9
XR8-2.29 ALIGNMENT OF X-RAY FIELD EDGES TO SELECTED PORTIONS OF THE IMAGE RECEPTOR . . . 6-15
XR8-2.30 ALIGNMENT OF CENTER OF X-RAY FIELD TO CENTER OF SELECTED PORTION OF IMAGE RECEPTOR . . . 6-19

7.0 MAINTENANCE/REPAIR . . . 7-1
7.1 CORRECTIVE MAINTENANCE . . . 7-2
7.2 REAR COVER REMOVAL AND REPLACEMENT . . . 7-2
7.3 FRONT COVER REMOVAL . . . 7-3
7.4 POSITION SENSING . . . 7-4
7.5 ADJUSTMENT OF CHASSIS SENSORS . . . 7-4
7.6 ESTABLISHING HOME POSITION OF CASSETTE CARRIAGE . . . 7-7
7.7 ADJUSTMENT OF HANDLE SENSORS . . . 7-8
7.8 INTERFACE CIRCUIT BOARD REMOVAL AND REPLACEMENT . . . 7-9
7.9 CPU CIRCUIT BOARD REMOVAL AND REPLACEMENT . . . 7-9
7.10 FRONT PANEL CIRCUIT BOARD REMOVAL AND REPLACEMENT . . . 7-10
7.11 STEPPER MOTOR REPLACEMENT . . . 7-11
7.12 CLUTCH/BRAKE ASSEMBLY REPLACEMENT . . . 7-12

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 10 - SPOT FILM DEVICE (continued)

7.13 BELT REPLACEMENT 7-13
7.13.1 FRONT-TO-BACK BELT REPLACEMENT 7-14
7.13.2 SIDE-TO-SIDE REPLACEMENT 7-15

8.0 THEORY OF OPERATION 8-1
8.1 MECHANICAL OPERATION 8-2
8.2 INTRODUCTION TO ELECTRONIC THEORY 8-2
8.3 BLOCK DIAGRAM DISCUSSION 8-3
8.4 CIRCUIT DESCRIPTION 8-3
8.4.1 CPU BOARD (70-08078) 8-5
8.4.2 INTERFACE BOARD (70-08077) 8-7
8.4.3 KEYBOARD/DISPLAY BOARD (70-08079) 8-9
8.4.4 POWER SUPPLY (70-10416) 8-10

9.0 NOT APPLICABLE FOR THIS MANUAL

10.0 SCHEMATICS AND BILLS OF MATERIAL 10-1

CHAPTER 11 - UNDER-TABLE COLLIMATOR

1.0 INTRODUCTION 1-1
1.1 YOU HAVE LEGAL OBLIGATIONS 1-3
1.2 BACKGROUND 1-3
1.3 LINEAR™ SERIES COLLIMATOR FEATURES 1-4
1.4 STANDARD FEATURES 1-5
1.5 SPECIFICATIONS 1-5
1.6 RADIATION AND MECHANICAL/ELECTRICAL WARNING 1-7
1.7 COMPATIBILITY 1-8
1.8 MAINTENANCE 1-8
1.9 COMPLIANCE REQUIREMENTS 1-9

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 11 - UNDER-TABLE COLLIMATOR (continued)

2.0 INSTALLATION 2-1
2.1 UNPACKING 2-3
2.2 EQUIPMENT SUPPLIED 2-3
2.3 COLLIMATOR MOUNTING AND INTERFACING 2-3
2.4 LOGIC ASSEMBLY INTERFACING 2-9
2.5 SID MONITOR POTENTIOMETER ADJUSTMENT 2-10

3.0 CALIBRATION 3-1
3.1 GENERAL DESCRIPTION 3-3
3.2 SERVICE ADJUSTMENTS, CONTROLS AND INDICATORS 3-4
3.3 +5 VOLT A/D REFERENCE CALIBRATION 3-11
3.4 SPOTFILM REFERENCE VOLTAGE CALIBRATION 3-11
3.5 COLLIMATOR HEAD REFERENCE VOLTAGE CALIBRATION . . 3-11
3.6 CONTINUOUS SID ADJUSTMENT 3-11
3.7 COLLIMATOR SHUTTER CALIBRATION 3-13

4.0 OPERATIONAL CHECKOUT PROCEDURE 4-1
4.1 DESCRIPTION 4-3
4.2 COLLIMATOR CENTERING ALIGNMENT 4-3
4.3 FLUOROSCOPIC IMAGE SIZE (I.I.) ADJUSTMENT 4-3
4.4 1-ON-1 (FULL) FILM ADJUSTMENT 4-4
4.5 2-ON-1 LONGITUDINAL FILM ADJUSTMENT 4-4
4.6 2-ON-1 TRANSVERSE FILM ADJUSTMENT 4-5
4.7 3-ON-1 FILM ADJUSTMENT 4-5
4.8 4-ON-1 FILM ADJUSTMENT 4-5
4.9 6-ON-1 FILM ADJUSTMENT 4-6
4.10 9-ON-1 FILM ADJUSTMENT 4-6
4.11 SID TRACKING VERIFICATION 4-6

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 11 - UNDER-TABLE COLLIMATOR (continued)

5.0 COMPLIANCE VERIFICATION 5-1
5.1 VERIFICATION TESTS TO BE PERFORMED 5-3
XR8-2.09 BEAM QUALITY 5-4
XR8-2.16 MINIMUM FIELD SIZE 5-9
XR8-2.20 X-RAY FIELD LIMITATION AND ALIGNMENT 5-11
XR8-2.24 FLUOROSCOPIC X-RAY FIELD LIMITATION 5-14
XR8-2.25 FLUORO SOURCE-TO-SKIN DISTANCE 5-22
XR8-2.27 PRIMARY BARRIER - X-RAY LOCKOUT 5-25
XR8-2.29 ALIGNMENT OF X-F EDGES TO IMAGE RECEPTOR 5-25
XR8-2.30 ALIGNMENT OF CENTER OF X-F IMAGE RECEPTOR 5-27
RECORD SHEET 5-31

6.0 NOT APPLICABLE FOR THIS MANUAL

7.0 THEORY OF OPERATION 7-1
7.1 MECHANICAL OPERATION 7-4
7.2 ELECTRONIC OPERATION 7-4

8.0 APPENDIX 8-1
DEFINITIONS 8-2

9.0 SCHEMATICS AND BILLS OF MATERIAL 9-1

CHAPTER 12 - OVER-TABLE COLLIMATOR

1.0 INTRODUCTION 1-1
1.1 YOU HAVE LEGAL OBLIGATIONS 1-3
1.2 BACKGROUND 1-3
1.3 COLLIMATOR FEATURES 1-4
1.4 STANDARD FEATURES 1-4
1.5 ADVANCED FEATURES 1-5
1.6 TECHNICALLY ADVANCED FEATURES 1-5

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 12 - OVER-TABLE COLLIMATOR (continued)

1.7 SPECIFICATIONS . . . 1-5
1.8 RADIATION AND MECHANICAL/ELECTRICAL WARNING . . . 1-6
1.9 COMPATIBILITY . . . 1-7
1.10 MAINTENANCE . . . 1-7
1.11 COMPLIANCE REQUIREMENTS . . . 1-7

2.0 INSTALLATION . . . 2-1
2.1 UNPACKING . . . 2-3
2.2 EQUIPMENT SUPPLIED . . . 2-3
2.3 COLLIMATOR MOUNTING . . . 2-3
2.4 POWER CHASSIS MOUNTING . . . 2-3
2.5 INTERCONNECT WIRING . . . 2-4

3.0 OPERATIONAL CHECKOUT PROCEDURE . . . 3-1
3.1 COLLIMATOR COVER REMOVAL . . . 3-2
3.2 COLLIMATOR TILT SWITCH CHECKOUT . . . 3-3
3.3 TABLE TILT SWITCH CHECKOUT (TILTING TABLES ONLY) . . . 3-4
3.4 LOGIC AND COLLIMATOR OPERATION CHECKOUT . . . 3-4
3.5 EXTERNAL SID SIGNAL CHECKOUT (HORIZONTAL) . . . 3-5
3.6 TILT TABLE RECEPTOR SID SIGNAL CHECKOUT . . . 3-6
3.7 EXTERNAL IR SIGNALS CHECKOUT . . . 3-6
3.8 EXTERNAL IR SIGNALS CHECKOUT FOR TILTING TABLES . . . 3-7
3.9 STEREO/TOMO BYPASS SIGNAL CHECKOUT . . . 3-7
3.10 INPUT SIGNAL VERIFICATION CHART . . . 3-8
3.11 INPUT FINAL TEST SWITCH SETTINGS . . . 3-8

4.0 ADJUSTMENT PROCEDURE . . . 4-1
4.1 LIGHT FIELD/X-RAY FIELD CONGRUENCE TEST . . . 4-2
4.2 40" SID ADJUSTMENT . . . 4-3
4.3 COLLIMATOR FEEDBACK LINEARITY TEST . . . 4-4
4.4 72" SID ADJUSTMENT . . . 4-5
4.5 CASSETTE TRAY ADJUSTMENT . . . 4-5

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 12 - OVER-TABLE COLLIMATOR (continued)

5.0 ALIGNMENT PROCEDURES **5-1**
5.1 FIELD PROJECTION LAMP AND MIRROR ADJUSTMENT 5-3
5.2 CROSS HAIR WINDOW ADJUSTMENT 5-3
5.3 BUCKY CENTERING LIGHT-LINE ADJUSTMENT 5-3
5.4 COLLIMATOR POTENTIOMETER VOLTAGE ADJUSTMENT 5-4

6.0 COMPLIANCE VERIFICATION **6-1**
6.1 VERIFICATION TESTS TO BE PERFORMED 6-3
XR8/2.14 VISUAL DEFINITION OF X-RAY LIGHT FIELD 6-5
XR8/2.15 INTENSITY OF LIGHT FIELD ILLUMINATION 6-9
XR8/2.16 MINIMUM FIELD SIZE 6-10
XR8/2.17 X-RAY FIELD RECEPTOR CENTER ALIGNMENT 6-12
XR8/2.18 INDICATION OF FIELD SIZE 6-12
XR8/2.19 POSITIVE BEAM LIMITATION (PBL) 6-13
XR8/2.20 X-RAY FIELD LIMITATION AND ALIGNMENT 6-14
XR8/2.21 RETURN TO PBL WITH IR CHANGE 6-16
XR8/2.22 KEYLOCK PBL OVERRIDE 6-16
XR8/2.09 DETERMINATION OF HALF VALUE LAYER 6-17

7.0 NOT APPLICABLE FOR THIS MANUAL

8.0 APPENDIX **8-1**

9.0 THEORY OF OPERATION **9-1**
9.1 MECHANICAL OPERATION 9-3
9.2 ELECTRONIC OPERATION 9-3

10.0 BILLS OF MATERIAL AND SCHEMATICS **10-1**

CHAPTER 13 - AUTOMATIC EXPOSURE CONTROL

1.0 INTRODUCTION **1-1**

2.0 OPERATING INSTRUCTIONS **2-1**
2.1 OPERATING CONDITIONS 2-1
2.2 OPERATOR CONTROLS 2-2

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 13 - AUTOMATIC EXPOSURE CONTROL (continued)

3.0 SPECIFICATIONS 3-1
3.1 SYSTEM PERFORMANCE 3-1
3.2 ION CHAMBER 3-2
3.3 CONTROLS AND DISPLAYS 3-2
3.4 INTERFACE REQUIREMENTS 3-3
3.5 POWER CONSUMPTION 3-3
3.6 PHYSICAL PARAMETERS 3-3
3.7 SCHEDULED MAINTENANCE 3-4
3.8 REGULATORY COMPLIANCE 3-4

4.0 INSTALLATION INSTRUCTIONS 4-1

5.0 FIELD CALIBRATION INSTRUCTIONS 5-1
5.1 PRELIMINARY STEPS 5-2
5.2 CAUTION 5-2
5.3 KVP LEVEL ADJUSTMENT 5-5
5.4 CHAMBER GAIN (MAIN DENSITY) ADJUSTMENT 5-5
5.5 FIELD MATCHING 5-6
5.6 KVP COMPENSATION 5-7
5.7 CONCLUSION OF FIELD CALIBRATION 5-8

6.0 PRINCIPLES OF OPERATION 6-1
6.1 BASIC SYSTEM BLOCKS 6-1
6.2 DIAGNOSTIC/TROUBLESHOOTING GUIDE 6-3
6.3 FACTORY CALIBRATION INSTRUCTIONS 6-8

7.0 DOCUMENTATION
7.1 SCHEMATIC DIAGRAMS 7-1
7.2 COMPONENT LOCATION DIAGRAMS 7-9
7.3 REPLACEMENT PARTS LIST 7-18

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 14 - IMAGE INTENSIFIER

1 GENERAL 1-1
1.1 SCOPE 1-1
1.2 DESCRIPTION 1-1
1.3 SPECIFICATIONS 1-3
1.3.1 PHYSICAL DIMENSIONS 1-3
1.3.2 WEIGHT 1-3
1.3.3 ELECTRICAL 1-3
1.3.4 OPTICAL CHARACTERISTICS 1-4
1.3.5 MISCELLANEOUS 1-4
1.4 EQUIPMENT SUPPLIED 1-4
1.4.1 EQUIPMENT REQUIRED BUT NOT SUPPLIED 1-4
1.4.2 TEST EQUIPMENT 1-4

2 THEORY OF OPERATION 2-1
2.1 INTRODUCTION 2-1
2.2 IMAGE INTENSIFICATION TUBE 2-1
2.3 POWER SUPPLY 2-1
2.3.1 LOW VOLTAGE SUPPLY 2-1
2.3.2 DC-TO-AC HIGH VOLTAGE CONVERTER 2-4
2.3.3 STABILIZATION AND CONTROL OF OUTPUT VOLTAGE V5 . . . 2-4
2.3.4 OUTPUT VOLTAGE (V5) MULTIPLIER 2-4
2.3.5 VOLTAGE DIVIDER 2-4

3 MAINTENANCE 3-1
3.1 GENERAL MAINTENANCE 3-1
3.2 STORAGE MAINTENANCE 3-1
3.3 IMAGE TUBE FOCUS 3-2
3.4 REPLACING THE POWER SUPPLY 3-3

4 PARTS LIST 4-1

TABLE OF CONTENTS

VOLUME II

SECTION PAGE

CHAPTER 15 - X-RAY TUBES

1 **RAD-13 OVERTABLE ROTATING ANODE X-RAY TUBE** **1-1**
1.1 PRODUCT DATA 1-1
1.2 60 HZ RADIOGRAPHIC EXPOSURE CHARTS 1-2
1.3 60 HZ FILAMENT EMISSION CHARTS 1-3
1.4 50 HZ RADIOGRAPHIC EXPOSURE CHARTS 1-4

2 **RAD-14 UNDERTABLE ROTATING ANODE X-RAY TUBE** **2-1**
2.1 PRODUCT DATA 2-1
2.2 60 HZ RADIOGRAPHIC EXPOSURE CHARTS 2-2
2.3 60 HZ FILAMENT EMISSION CHARTS 2-3
2.4 50 HZ RADIOGRAPHIC EXPOSURE CHARTS 2-4

CHAPTER 16 - MISCELLANEOUS

1 **MOBILE CASSETTE HOLDER** **1-1**

2 **LATERAL CASSETTE/GRID HOLDER** **2-1**

3 **MCT SIZE-SENSING TRAY** **3-1**

4 **RADIATION SHIELD** **4-1**

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 1 - GENERAL

1-1 CS-8952 X-RAY SYSTEM 1-4
1-2 HARD WALL SHELTER CONFIGURATION 1-5
1-3 A TYPICAL HOSPITAL CONFIGURATION 1-6

CHAPTER 2 - INSTALLATION

1-1 EQUIPMENT LAYOUT, OPERATIONAL MODE 1-2
1-2 EQUIPMENT LAYOUT, OPERATIONAL SYSTEM FREE STANDING 1-3
1-3 CS-8952 SYSTEM INSTALLATION IN AN EXPANDABLE ONE-SIDED TACTICAL SHELTER 1-4
1-4 INTEGRATED CONFIGURATION: TRANSPORT DEVICE 1-8
1-5 CRANE FORKS 1-9
1-6 CTC TUBESTAND, WITH CRANE FORKS IN THE SLOTS 1-12
1-7 VERTICAL CARRIAGE SHIPPING BRACKET 1-13
1-8 LONGITUDINAL CARRIAGE SHIPPING BRACKET 1-14
1-9 TRANSVERSE ARM LOCKING BOLT 1-15
1-10 TRANSPORT DEVICE: SEPARATED CONFIGURATION 1-17
1-11 TABLE SPRING LOADED CHECK 1-19
1-12 INSIDE TABLE VIEW OF HEAD-END, WITH CRANE FORK PINS 1-20
1-13 TABLE LATERAL CARRIAGE SHIPPING BRACKET 1-21
1-14 TABLE FLUORO SHIPPING BRACKET 1-22
1-15 TABLE TOP REMOVAL 1-24
1-16 TABLE FRONT COUNTERWEIGHT INSTALLATION 1-26
1-17 TABLE REAR COUNTERWEIGHT INSTALLATION 1-27
1-18 ISO SHELTER FLOOR INSERT PATTERN 1-28
1-19 RADIATION SHIELD 1-30
1-20 TRANSFORMER AND TRANSPORT DEVICE 1-32
1-21 MAIN CONTROL AND TRANSPORT DEVICE 1-33
1-22 PANEL AND CABLE MOUNTING 1-37
1-23 UNDER-TABLE (FLUOROSCOPIC) COLLIMATOR & X-RAY TUBE MOUNTING 1-39
1-24 MOUNTING OF SPOT FILM DEVICE 1-41
1-25 IMAGING INTENSIFIER SYSTEM PLACEMENT 1-42
1-26 SYSTEM LAYOUT, ISO SHELTER 1-44
1-27 SYSTEM LAYOUT, FREESTANDING 1-45

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 2 - INSTALLATION (continued)

1-28 MOUNTING OVER-TABLE TUBE AND COLLIMATOR 1-46
1-29 ECCENTRIC BEARINGS FOR PLUMBING THE TABLE TOWER 1-50

2-1 TRANSPORT DEVICE ASSEMBLY 2-2

CHAPTER 3 - CALIBRATION

2-1 MXR-350 MAIN CONTROL, PART 1 2-2
2-2 MXR-350 MAIN CONTROL, PART 2 2-3
2-3 OPERATOR PANEL MAIN CONTROL 2-6
2-4 60 HZ TIMER SELECT DECK 2-7
2-5 50 HZ TIMER SELECT DECK 2-8
2-6 POWER CIRCUIT 2-10
2-7 MA KVP-LINE METER SHUNT PCB 2-12
2-8 KVP COMPENSATION PANEL 2-27
2-9 SCOPE READING FOR 2.5.3 2-28
2-10 ROTOR CONTROL PCB 2-30
2-11 TOLA ASSEMBLY PCB 2-32
2-12 SCOPE READING FOR 2.7, STEP 5 2-35
2-13 SCOPE READING FOR RADIOGRAPHIC TIMER, 60 HZ & 50 HZ 2-36
2-14 SINGLE PHASE IMPULSE TIMER 2-37
2-15 BACK UP TIMER 2-41
2-16 SCR IMPULSE TIMER 2-42
2-17 SCOPE READING FOR 2.8.7 (60 HZ), 2.8.8 (50 HZ) 2-43
2-18 SCOPE READING FOR 2.8.9 (60 HZ), 2.8.10 (50 HZ) 2-44
2-19 BOOST WAVEFORMS 2-47
2-20 CONSTANT CURRENT FILAMENT CONTROL ASSEMBLY 2-48
2-21 FLUORO MA CONTROL PCB 2-62
2-22 MAS CURRENT INTEGRATOR PCB 2-63
2-23 EXPOSURE END BUZZER 2-64

4-1 UNDER-TABLE LOGIC PCB 4-4
4-2 COLLIMATOR CENTERING 4-21
4-3 FLUOROSCOPIC SHUTTER ALIGNMENT 4-22

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 3 - CALIBRATION (continued)

5-1 OVER-TABLE COLLIMATOR 5-2
5-2 LEDS AND TEST POINTS LOCATION 5-4
5-3 SWITCHES LOCATION 5-4
5-4 LIGHT FIELD/X-RAY CONGRUENCE TEST 5-13
5-5 LIGHT FIELD ADJUSTMENT 5-21
5-6 TEST PATTERN 5-25

6-1 ADJUSTMENT COMPONENT LOCATIONS 6-3
6-2 PREAMPLIFIER ADJUSTMENT COMPONENT LOCATION 6-4

CHAPTER 4 - TROUBLESHOOTING

NO FIGURES

CHAPTER 5 - OPERATION

1-1 CS-8952 X-RAY SYSTEM 1-3
1-2 HARD WALL SHELTER CONFIGURATION 1-4
1-3 A TYPICAL HOSPITAL CONFIGURATION 1-5
2-1 GENERATOR MAIN CONTROL PANEL 2-2
2-2 SPOT FILM FRONT CONTROL PANEL 2-8
2-3 SPOT FILM DEVICE SELECTED DISPLAY 2-14
2-4 TABLE CONTROL PANEL 2-16
2-5 TUBESTAND AND COLLIMATOR CONTROLS 2-19
2-6 IMAGING SYSTEM 2-20
2-7 FOOT REST 2-26
2-8 SHOULDER REST 2-27
2-9 PATIENT HAND GRIPS 2-28
2-10 COMPRESSION BAND 2-29
2-11 UROLOGICAL KNEE CRUTCHES 2-30
2-12 HEAD HOLDER 2-31
2-13 LATERAL CASSETTE HOLDER 2-32
2-14 PATIENT FOOTSTEP 2-33
2-15 MOBILE GRID/CASSETTE/HOLDER 2-34
2-16 CASSETTE SENSING TRAY 2-35

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 6 - MXT-350 GENERATOR

1-1 RADIOGRAPHIC/FLUOROSCOPIC GENERATOR, MXR-350 1-2
1-2 MAIN CONTROL MXR-350, OPERATOR'S CONTROL PANEL 1-3

2-1 CFD 1.0 2-2
2-2 CFD 1.1 2-5
2-3 CFD 1.2 2-8
2-4 CFD 1.3 2-10
2-5 CFD 2.0 2-12
2-6 EXPOSURE INTERLOCK PCB 2-13
2-7 CFD 2.1 2-16
2-8 CFD 2.2 2-19
2-9 CFD 2.4 2-22
2-10 CFD 2.6 2-24
2-11 CFD 3.0 2-26
2-12 CFD 3.1 2-29
2-13 CFD 3.2 2-31
2-14 CFD 3.3 2-34
2-15 CFD 3.4 2-37
2-16 CFD 4.0 2-40
2-17 CFD 5.0 2-42
2-18 CFD 5.1 2-46
2-19 CFD 6.0 2-49
2-20 CFD 6.2 2-53
2-21 CFD 6.3 2-56
2-22 CFD 7.0 2-58
2-23 CFD 8.1 2-62
2-24 RELAY MATRIX PCB 2-63
2-25 CFD 9.0 2-67
2-26 CFD 9.3 2-69
2-27 CFD 9.4 2-71

3-1 CONSTANT CURRENT MULTIPLEX FILAMENT 3-3

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 6 - MXT-350 GENERATOR (continued)

5-1 MXR-350 WIRING DIAGRAM 5-2
5-2 CONTROL ASM (PART 1) 5785.234.01 5-3
5-3 CONTROL ASM (PART 2) 5785.234.01 5-4
5-4 LAYOUT FOR 5184.234.03
MXR-350 AUX TECHNIQUE PNL ASM 5-12
5-5 SCHEMATIC FOR 5184.234.03
MXR-350 AUX TECHNIQUE PNL ASM 5-14
5-6 LAYOUT FOR 5184.234.0310
MXR-350 ION CHAMBER PKUP & DENSITY 5-15
5-7 SCHEMATIC FOR 5184.234.0310
MXR-350 ION CHAMBER PKUP & DENSITY 5-18
5-8 LAYOUT FOR 5184.234.0320
MXR-350 SPOT FILM CHANGEOVER PCB 5-19
5-9 SCHEMATIC FOR 5184.234.0320
MXR-350 SPOT FILM CHANGEOVER PCB 5-21
5-10 LAYOUT FOR 5184.234.04
MXR-350 MA TECH SELECT SWITCH ASM 5-22
5-11 SCHEMATIC FOR 5184.234.04
MXR-350 MA TECH SELECT SWITCH ASM 5-24
5-12 LAYOUT FOR 5184.234.0410
MXR-350 ION CHAMBER POWER-RESET-FIELD SWITCH 5-25
5-13 SCHEMATIC FOR 5184.234.0410
MXR-350 ION CHAMBER POWER-RESET-FIELD SWITCH 5-27
5-14 LAYOUT FOR 5184.234.0501
MXR-350 FLUORO MA CONTROL BOARD ASM 5-28
5-15 SCHEMATIC FOR 5184.234.0501
FLOURO MA CONTROL BOARD ASM 5-30
5-16 LAYOUT FOR 5184.234.06
MXR-350 TIMER SAFETY SWITCH ASM 5-31
5-17 SCHEMATIC FOR 5184.234.06
MXR-350 TIMER SAFETY SWITCH ASM 5-33
5-18 LAYOUT FOR 5184.234.0601
MXR-350 60 HZ IMPULSE TIMER RSTR ASM 5-34

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 6 - MXT-350 GENERATOR (continued)

5-19 SCHEMATIC FOR 5184.234.0601
MXR-350 60 HZ IMPULSE TIMER RSTR ASM 5-36
5-20 LAYOUT FOR 5184.234.0690
MXR-350 UNIVERSAL TOLA RESISTOR ASM 5-37
5-21 SCHEMATIC FOR 5184.234.0690
MXR-350 UNIVERSAL TOLA RESISTOR ASM 5-39
5-22 LAYOUT FOR 5184.234.0698
MXR-350 BACKUP TIMER RESISTOR ASM 5-40
5-23 SCHEMATIC FOR 5184.234.0698
MXR-350 BACKUP TIMER RESISTOR ASM 5-42
5-24 LAYOUT FOR 5184.234.0699
MXR-350 50 HZ IMPULSE TIMER RESISTOR ASM 5-43
5-25 SCHEMATIC FOR 5184.234.0699
MXR-350 50 HZ IMPULSE TIMER RESISTOR ASM 5-45
5-26 LAYOUT FOR 5184.234.08
MXR-350 PREP/EXP PANEL ASM 5-46
5-27 SCHEMATIC FOR 5184.234.08
MXR-350 PREP/EXP PANEL ASM 5-48
5-28 LAYOUT FOR 5184.234.09
MXR-350 FLUORO KVP METER SHUNT ASM 5-49
5-29 SCHEMATIC FOR 5184.234.09
MXR-350 FLUORO KVP METER SHUNT ASM 5-51
5-30 LAYOUT FOR 5184.234.10
MXR-350 FLUORO EXPOSURE INDICATOR ASM 5-52
5-31 SCHEMATIC FOR 5184.234.10
MXR-350 FLUORO EXPOSURE INDICATOR ASM 5-54
5-32 LAYOUT FOR 5184.234.11
MXR-350 SFD PREP DELAY RELAY ASM 5-55
5-33 SCHEMATIC FOR 5184.234.11
MXR-350 SFD PREP DELAY RELAY ASM 5-57
5-34 LAYOUT FOR 5184.234.12
MXR-350 SINGLE PHASE IMPULSE TIMER ASM 5-58
5-35 SCHEMATIC FOR 5184.234.12
MXR-350 SINGLE PHASE IMPULSE TIMER ASM 5-61
5-36 LAYOUT FOR 5184.234.19
MXR-350 FILAMENT DRIVE TRANSISTOR ASM 5-62

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 6 - MXT-350 GENERATOR (continued)

5-37 SCHEMATIC FOR 5184.234.19
MXR-350 FILAMENT DRIVE TRANSISTOR ASM 5-64
5-38 LAYOUT FOR 5184.234.2901
MXR-350 24 VDC EXP END BUZZ ASM 5-65
5-39 SCHEMATIC FOR 5184.234.2901
MXR-350 24 VDC EXP END BUZZ ASM 5-67
5-40 LAYOUT FOR 5281.234.02
MXR-350 TIMER SWITCH ASM 5-68
5-41 LAYOUT FOR 5284.234.1102
MXR-350 235A 800V IMPULSE TIMER /CONTACTOR 5-70
5-42 LAYOUT FOR 5284.234.15
MXR-350 3P FILAMENT RESISTOR PNL ASM 5-72
5-43 SCHEMATIC FOR 5284.234.15
MXR-350 3P FILAMENT RESISTOR PNL ASM 5-74
5-44 LAYOUT FOR 5285.234.01
MXR-350 3P FILAMENT DRIVE COOLING ASM 5-75
5-45 LAYOUT FOR 5285.234.02
MXR-350 CONSTANT VOLTAGE TRANSFORMER ASM 5-77
5-46 LAYOUT FOR 5285.234.03
MXR-350 RESISTOR PANEL ASM 5-79
5-47 LAYOUT FOR 5286.234.04
MXR-350 AUX PWR SUPPLY 50/60 HZ XFNR ASM 5-81
5-48 LAYOUT FOR 5286.234.05
MXR-350 FIL XFMR SUPPLY ASM 50/60 HZ 5-83
5-49 LAYOUT FOR 5485.234.01
MXR-350 TAP SWITCHES PANEL ASM 5-85
5-50 LAYOUT FOR 5585.234.02
MXR-350 CONTACTOR PANEL ASM 5-87
5-51 LAYOUT FOR 6184.234.0803
MXR-350 MAS METER CURRENT INTEGRATOR ASM 5-90
5-52 SCHEMATIC FOR 6184.234.0803
MXR-350 MAS METER CURRENT INTEGRATOR ASM 5-93
5-53 LAYOUT FOR 6284.234.01
MXR-350 UNIVERSAL TOLA ASM 5-94
5-54 SCHEMATIC FOR 6284.234.01
MXR-350 UNIVERSAL TOLA ASM 5-97

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 6 - MXT-350 GENERATOR (continued)

5-55 LAYOUT FOR 6284.234.02
MXR-350 AUX RELAY PNL ASM 5-98
5-56 SCHEMATIC FOR 6284.234.02
MXR-350 AUX RELAY PNL ASM 5-100
5-57 LAYOUT FOR 6284.234.03
MXR-350 KVP COMPENSATION PNL ASM 5-101
5-58 SCHEMATIC FOR 6284.234.03
MXR-350 KVP COMPENSATION PNL ASM 5-103
5-59 LAYOUT FOR 6284.234.04
MXR-350 EXP INTERLOCK PNL ASM 5-104
5-60 SCHEMATIC FOR 6284.234.04
MXR-350 EXP INTERLOCK PNL ASM 5-107
5-61 LAYOUT FOR 6284.234.0803
MXR-350 BACKUP TIMER PANEL ASM 5-108
5-62 SCHEMATIC FOR 6284.234.0803
MXR-350 BACKUP TIMER PANEL ASM 5-111
5-63 LAYOUT FOR 6284.234.09
MXR-350 ROTOR CONTROL W/PHOTOTRANSISTORS 5-112
5-64 SCHEMATIC FOR 6284.234.09
MXR-350 ROTOR CONTROL W/PHOTOTRANSISTORS 5-116
5-65 LAYOUT FOR 6284.234.1009
MXR-350 CONSTANT CURRENT FILAMENT CONTROL ASM 5-117
5-66 SCHEMATIC FOR 6284.234.1009
MXR-350 CONSTANT CURRENT FILAMENT CONTROL ASM 5-121
5-67 LAYOUT FOR 6284.234.11
MXR-350 SCR CONTACTOR TIMER INTERFACE 5-122
5-68 SCHEMATIC FOR 6284.234.11
MXR-350 SCR CONTACTOR TIMER INTERFACE 5-125
5-69 LAYOUT FOR 6284.234.12
MXR-350 MA-KVP-LINE METER SHUNT ASM 5-126
5-70 SCHEMATIC FOR 6284.234.12
MXR-350 MA-KVP-LINE METER SHUNT ASM 5-128
5-71 LAYOUT FOR 6584.234.01
MXR-350 RELAY MATRIX ASM 5-129

LIST OF FIGURES

VOLUME I

FIGURE PAGE

CHAPTER 6 - MXT-350 GENERATOR (continued)

5-72 SCHEMATIC FOR 6584.234.01 MXR-350 RELAY MATRIX ASM 5-131
5-73 LAYOUT FOR 5184.323.02 75 KVP PLUG IN RECTIFIER ASM 5-132
5-74 SCHEMATIC FOR 5184.323.02 75 KVP PLUG IN RECTIFIER ASM 5-134
5-75 LAYOUT FOR 5484.323.02 PLUG-IN HV DIODE BRIDGE ASM 5-135
5-76 LAYOUT FOR 6360.009 150 KV PLUG-IN RECTIFIER ASM 5-137
5-77 ASSEMBLY DRAWING FOR 5786.323.03 MIL 2-TUBE HV TRANSFORMER TOP ASM 5-139
5-78 LAYOUT FOR 6635.300 TRANSFORMER ASSEMBLY 5-142

VOLUME II

CHAPTER 7 - MXT-90/15 TABLE

1-1 MXT-90/15 TABLE ASSEMBLY 1-2

2-1 TABLE TOP DRIVE CIRCUIT 2-2
2-2 TABLE TILT CONTROL 2-4
2-3 MAGNETIC LOCK CIRCUIT 2-6
2-4 POWER DISTRIBUTION 2-7

3-1 SPOT FILM DEVICE TOWER ASSEMBLY 3-3
3-2 FRONT COUNTERWEIGHTS 3-5
3-3 REAR COUNTERWEIGHTS 3-6
3-4 TABLE SIDE CONTROLS 3-8
3-5 TABLE TOP REMOVAL 3-12
3-6 LONGITUDINAL AND LATERAL LOCKS 3-16
3-7 TABLE TILT DRIVE CHAIN 3-19

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 7 - MXT-90/15 TABLE (continued)

4-1 TABLE WIRING DIAGRAM 4-2
4-2 LAYOUT FOR 5282.062.01
MILITARYITARY TABLE HE TERMINAL ASM 4-3
4-3 LAYOUT FOR 5284.062.04
POWER TOP LONG DRIVE PANEL ASM 4-5
4-4 SCHEMATIC FOR 5284.062.04
POWER TOP LONG DR PANEL ASM 4-7
4-5 LAYOUT FOR 5284.062.1801
MXT 90/15 TABLE 5 FUNCTION CONTROL SWITCH 4-8
4-6 SCHEMATIC FOR 5284.062.1801
MXT 90/15 TABLE 5 FUNCTION CONTROL SWITCH 4-10
4-7 LAYOUT FOR 5536.062.02
MILITARY TABLE\EUREKA TOWER CWT ASM 4-11
4-8 LAYOUT FOR 5736.060.04
AINSWORTH LONGITUDINAL CAR. ASM 4-13
4-9 LAYOUT FOR 5736.060.05
AINSWORTH LATERAL CARRIAGE ASM 4-18
4-10 LAYOUT FOR 5736.062.02
TABLE BODY ASM 4-21
4-11 LAYOUT FOR 5736.062.03
MILITARY R-F TABLE FRONT SKIRT ASM 4-31
4-12 LAYOUT FOR 5736.062.04
MILITARY BEARING TOP OUTER FRM ASM 4-33
4-13 LAYOUT FOR 5736.062.06
MILITARY R-F TABLE LEG ASM 4-35
4-14 LAYOUT FOR 5736.062.07
MILITARY TABLE/EUREKA ELEVATOR ASM 4-41
4-15 LAYOUT FOR 5736.062.08
MILITARY TABLE/EUREKA TOWER ASM 4-44
4-16 LAYOUT FOR 5736.062.09
MILITARY BEARING TOP INNER FRAME ASM 4-47
4-17 LAYOUT FOR 5536.009.06
TOP DRIVE CONTROL SWITCH ASM 4-51
4-18 LAYOUT FOR 5236.500.02
PATIENT HANDGRIP ASM 4-54
4-19 LAYOUT FOR 5436.504.02
UROLOGICAL RIGHT-HAND KNEE CRUTCH ASM 4-56

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 7 - MXT-90/15 TABLE (continued)

4-20 LAYOUT FOR 5436.504.03
UROLOGICAL LEFT-HAND KNEE CRUTCH ASM 4-58
4-21 LAYOUT FOR 5536.500.01
COMPRESSION BAND DEVICE ASM 4-60
4-22 LAYOUT FOR 5536.504.01
ADJUSTABLE SHOULDER REST ASM 4-63
4-23 LAYOUT FOR 5536.504.02
FOOTREST ASM 4-66
4-24 LAYOUT FOR 9491.201
VACUUM HEAD CLAMP 4-68

CHAPTER 8 - TUBESTAND

1-1 TUBESTAND ASSEMBLY 1-2

2-1 TUBESTAND SCHEMATIC 2-3

4-1 CTC MAIN WIRING DIAGRAM 4-2
4-2 5536.101.01
CTC MAIN FRAME ASM 4-3
4-3 5536.101.02
CTC VERTICAL & LATERAL CARRIAGE ASM 4-5
4-4 5536.101.05
HORIZONTAL CARRIAGE ASM 4-8
4-5 5536.101.06
CTC VERTICAL COLUMN ASM 4-10
4-6 6810.100
FLOOR-MOUNTED TUBESTAND ASM 4-13

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 9 - AUXILIARY BOX

1-1 AUXILIARY CIRCUIT BOX 1-2

2-1 AUXILIARY BOX WIRING DIAGRAM 2-2
2-2 TABLE TUBESTAND AUXILIARY BOX ASSEMBLY 2-3
2-3 LAYOUT FOR 6284.062.03 MXT 90/15 MAGNETIC LOCK POWER SUPPLY PCB 2-7
2-4 SCHEMATIC FOR 6284.062.03 MXT 90/15 MAGNETIC LOCK POWER SUPPLY PCB 2-9
2-5 LAYOUT FOR 6284.062.05 MXT 90/15 MOTOR CARRIAGE DRIVE PCB 2-10
2-6 SCHEMATIC FOR 6284.062.05 MXT 90/15 MOTOR CARRIAGE DRIVE PCB 2-12
2-7 LAYOUT FOR 6284.062.06 MXT 90/15 VARI-SPEED TILT CONTROL PCB 2-13
2-8 SCHEMATIC FOR 6284.062.06 MXT 90/15 VARI-SPEED TILT CONTROL PCB 2-15
2-9 LAYOUT FOR 6284.062.07 MXT 90/15 TABLE TILT CONTROL PCB 2-16
2-10 SCHEMATIC FOR 6284.062.07 MXT 90/15 TABLE TILT CONTROL PCB 2-18

CHAPTER 10 - SPOT FILM DEVICE

1.1 OUTLINE DATA 1-4

2.1 J7 WIRING 2-3
2.2 J8 WIRING 2-3
2.3 J9 WIRING 2-4

5.1 FRONT PANEL CONTROLS AND INDICATORS 5-4
5.2 FORMAT/STATUS DISPLAYS 5-7
5.3 POWER ASSIST HANDLE OPERATION 5-9

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 10 - SPOT FILM DEVICE (continued)

6.1 CDRH/FDA COMPLIANCE TEST STAND 6-2
6.2 COMPLIANCE TEST STAND DETAIL 6-2
6.3 FLUOROSCOPIC X-RAY FIELD LIMITATION, TEST STAND METHOD 6-10
6.4 FLUOROSCOPIC X-RAY FIELD LIMITATION, DIRECT METHOD 6-13
6.5 IMAGE INTENSIFIED FLUOROSCOPE, METAL MARKER METHOD, OUTSIDE EDGE 6-13
6.6 UNDER-TABLE TUBE, TEST SET-UP 6-14
6.7 DETERMINATION OF SID 6-17
6.8 SPOTFILM X-RAY FIELD LIMITATION, TEST STAND METHOD, REFERENCE 6-18
6.9 SPOTFILM X-RAY FIELD LIMITATION, TEST STAND METHOD, ACTUAL 6-18

7.1 REAR COVER REMOVAL 7-2
7.2 FRONT COVER REMOVAL 7-3
7.3 I.I. ADAPTER PLATE REMOVAL 7-3
7.4 CHASSIS SENSOR LOCATIONS 7-4
7.5 CASSETTE PRESENT SENSOR DETAIL 7-6
7.6 LOAD POSITION SENSOR DETAIL 7-6
7.7 PARK POSITION SENSORS DETAIL 7-6
7.8 POWER SUPPLY FRONT PANEL (F4) 7-7
7.9 SIDE MOVEMENT HANDLE SENSOR DETAIL 7-8
7.10 POWER ASSIST HANDLE ADJUSTMENT 7-8
7.11 INTERFACE CIRCUIT BOARD REMOVAL 7-9
7.12 CPU CIRCUIT BOARD REMOVAL 7-9
7.13 FRONT PANEL CIRCUIT BOARD REMOVAL 7-10
7.14 DRIVESHAFT DECOUPLING 7-10
7.15 SIDE-TO-SIDE BELT TENSIONING ADJUSTMENT 7-11
7.16 MOTOR REPLACEMENT 7-11
7.17 J6 WIRING 7-12
7.18 AC INPUT TERMINAL BLOCK DETAIL 7-12
7.19 CLUTCH/BRAKE REPLACEMENT 7-13
7.20 FRONT-TO-BACK BELT TENSIONING ADJUSTMENT 7-13
7.21 CASSETTE CARRIAGE TO BELT DISASSEMBLY 7-14
7.22 SIDE-TO-SIDE FRONT IDLER PULLEY DETAIL 7-14
7.23 LEADSCREW PULLEY SETSCREW DETAIL 7-15
7.24 LEADSCREW MOUNTING BRACKET REMOVAL 7-15

8.1 SYSTEM BLOCK DIAGRAM 8-4

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 10 - SPOT FILM DEVICE (continued)

8.2 SIMPLIFIED SCHEMATIC - KEYBOARD INTERFACE 8-8

10.1 POWER SUPPLY SCHEMATIC, 70-10416 10-5
10.2 Z80 INTERFACE BOARD ANALOG SCHEMATIC, 70-08077 10-8
10.3 Z80 INTERFACE BOARD DIGITAL SCHEMATIC, 70-08077 10-9
10.4 Z80 INTERFACE BOARD TERMINAL DESIGN, 70-08077 10-10
10.5 Z80 INTERFACE BOARD ASSEMBLY, 70-08077 10-11
10.6 Z80 CPU BOARD DIGITAL SCHEMATIC, 70-08078 10-14
10.7 Z80 CPU BOARD I/O SCHEMATIC, 70-08078 10-15
10.8 Z80 CPU BOARD ASSEMBLY, 70-07078 10-16
10.9 KEYBOARD/DISPLAY SCHEMATIC, 70-08079 10-19
10.10 KEYBOARD/DISPLAY ASSEMBLY, 70-08079 10-20

CHAPTER 11 - UNDER-TABLE COLLIMATOR

2.1 COMPONENT IDENTIFICATION 2-2
2.2 COLLIMATOR TO FOCAL SPOT DISTANCE 2-4
2.3 COLLIMATOR/TUBE MOUNTING 2-6
2.4 COLLIMATOR INTERCONNECT CABLING 2-7
2.5 J2 LOGIC WIRING 2-8
2.6 J1 LOGIC WIRING 2-9

3.1 LOGIC BOARD CALIBRATION 3-2

4.1 COLLIMATOR CENTERING 4-2
4.2 FLUOROSCOPIC I.R. SHUTTER ALIGNMENT 4-2

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 11 - UNDER-TABLE COLLIMATOR

5.1 CDRH/FDA COMPLIANCE TEST STAND 5-2
5.2 COMPLIANCE TEST STAND DETAIL 5-2
5.3 BEAM QUALITY GRAPHING EXAMPLES 5-8
5.4 FLUOROSCOPIC X-RAY FIELD LIMITATION, TEST STAND METHOD 5-15
5.5 FLUOROSCOPIC X-RAY FIELD LIMITATION, DIRECT METHOD 5-17
5.6 IMAGE INTENSIFIED FLUOROSCOPE, TEST SET-UP 5-20
5.7 IMAGE INTENSIFIED FLUOROSCOPE, METAL MARKER METHOD, INSIDE EDGE 5-20
5.8 IMAGE INTENSIFIED FLUOROSCOPE, METAL MARKER METHOD, OUTSIDE EDGE 5-21
5.9 UNDER-TABLE TUBE, TEST SET-UP 5-21
5.10 FOCAL SPOT GEOMETRY 5-24
5.11 CALCULATION EXAMPLE 5-29
5.12 SPOTFILM X-RAY FIELD LIMITATION, TEST STAND METHOD, REFERENCE 5-30
5.13 SPOTFILM X-RAY FIELD LIMITATION, TEST STAND METHOD, ACTUAL 5-30

7.1 BLOCK DIAGRAM, ANALOG SECTION 7-2
7.2 BLOCK DIAGRAM, DIGITAL SECTION 7-3

9.1 UNDER-TABLE LOGIC PCB DIGITAL SCHEMATIC, 70-08084 9-5
9.2 UNDER-TABLE LOGIC PCB ANALOG SCHEMATIC, 70-080884 9-6
9.3 UNDER-TABLE LOGIC PCB ASSEMBLY DRAWING, 70-08084 9-7
9.4 FSE DRIVER PCB ASSEMBLY SCHEMATIC, 70-08083 9-10
9.5 FSE DRIVER PCB ASSEMBLY, 70-08083 9-11

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 12 - OVER-TABLE COLLIMATOR

1.1 FRONT PANEL INDICATORS AND COLLIMATOR OPERATION 1-2

2.1 COMPONENT IDENTIFICATION 2-2
2.2 COLLIMATOR TO FOCAL SPOT DISTANCE 2-6
2.3 POWER CHASSIS MOUNTING DIMENSIONS 2-6
2.4 CABLING OUTLINE 2-7
2.5A,B,C TERMINAL STRIP CONNECTIONS . . . . 2-7 AND 2-8
2.6 EXPOSURE INTERLOCK CONNECTIONS (EXPOSURE HOLD CIRCUIT) . . 2-9
2.7 TOMO/STEREO BYPASS CONNECTIONS 2-9
2.8 CASSETTE TRAY CIRCUIT 2-9
2.9A,B HORIZONTAL SID CONNECTIONS 2-10
2.10 TABLE TILT MONITOR CONNECTIONS 2-10
2.11 TABLE TILT MONITOR CONNECTIONS 2-10

3.0 TOP AND BOTTOM COVER REMOVAL 3-2
3.1 LOGIC P.C.B. LED LOCATIONS 3-10
3.2 LOGIC P.C.B. SWITCH LOCATIONS 3-10

4.1 LIGHT FIELD VS. X-RAY FIELD CONGRUENCY 4-3
4.2 CASSETTE TRAY POTENTIOMETER WIRING 4-5
5.1 LIGHT FIELD AND BUCKY LIGHT LINE ADJUSTMENT 5-2

6.1 BRH/FDA COMPLIANCE TEST STAND 6-2
6.2 COMPLIANCE STAND DETAIL 6-2
6.3 LIGHT FIELD VS. X-RAY FIELD ERROR MEASUREMENTS 6-4
6.4 DETERMINATION OF SID 6-6
6.5 METAL MARKER METHOD 6-6
6.6 BEAM QUALITY GRAPHING EXAMPLES 6-20

9.1 COLLIMATOR HEAD MECHANICAL VIEW 9-2
9.2 BLOCK DIAGRAM 9-3
9.3 TILT SWITCH FUNCTIONS 9-5

10.1 FEEDBACK POT AND MOTOR WIRING 10-3
10.2 LOGIC BOARD SCHEMATIC (70-08080) 10-7
10.3 LOGIC BOARD ASSEMBLY (70-08080) 10-8
10.4 MASTER BOARD SCHEMATIC (70-08081) 10-11
10.5 MASTER BOARD ASSEMBLY (70-08081) 10-12
10.6 LAMP & DRIVER BOARD SCHEMATIC (70-08082) 10-15
10.7 LAMP & DRIVER BOARD ASSEMBLY (70-08082) 10-16

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 13 - AUTOMATIC EXPOSURE CONTROL

2.1 OPERATOR CONTROLS 2-3

5.1 ADJUSTMENT COMPONENT LOCATIONS 5-3
5.2 PREAMPLIFIER ADJUSTMENT COMPONENT LOCATIONS 5-4

6.1 BASIC SYSTEM BLOCKS 6-2
6.2 FACTORY ADJUSTMENT COMPONENT LOCATIONS 6-9
6.3 MULTIPLIER GAIN ADJUSTMENT 6-14
6.4 PREAMPLIFIER ADJUSTMENT COMPONENT LOCATIONS 6-17
6.5 PREAMPLIFIER ADJUSTMENT COMPONENT LOCATIONS 6-17

SCHEMATIC DIAGRAMS

7.1 S60899B INPUT AMPLIFIER BOARD 7-1
7.2 S60900F LOGIC CONTROL BOARD 7-2
7.3 S60907D KVP COMPUTER BOARD 7-3
7.4 S60916C POWER SUPPLY BOARD 7-4
7.5 S61017C DISPLAY BOARD 7-5
7.6 WA3365A INTERCONNECTION DRAWING 7-6
7.7 S60917C THREE FIELD PREAMPLIFIER 7-7
7.8 S60940D SINGLE FIELD PREAMPLIFIER 7-8

COMPONENT LOCATION DIAGRAMS

7.9 60899B INPUT AMPLIFIER BOARD 7-9
7.10 60900F LOGIC CONTROL BOARD 7-10
7.11 60907D KVP COMPUTER BOARD 7-11
7.12 60916C POWER SUPPLY BOARD 7-12
7.13 60917C THREE FIELD PREAMPLIFIER 7-13
7.14 60940D SINGLE FIELD PREAMPLIFIER 7-14
7.15 61017C INTERNAL DISPLAY BOARD 7-15
7.16 60932C TOP BUS BOARD 7-16
7.17 60905D BOTTOM BUS BOARD 7-16
7.18 61061A DISPLAY CONNECTOR BOARD 7-16
7.19 74047A EXPOS-AID A3365 ASSEMBLY 7-17

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 14 - IMAGE INTENSIFIER

1-1 IMAGE INTENSIFICATION SYSTEM OVERVIEW 1-2

2-1 FOCUSING ELECTRONS 2-2
2-2 IMAGE INTENSIFIER POWER SUPPLY CIRCUIT 2-3

3-1 POTENTIOMETER LOCATIONS 3-4

4-1 LAYOUT FOR 5536.822.04 MIL 6" MIRROR/LENS SUPPORT MNT ASM 4-2
4-2 LAYOUT FOR 5536.822.05 6" EUREKA/THOMSON OPTICS SPRT ASM 4-5

CHAPTER 15 - X-RAY TUBES

1-1 SINGLE PHASE, FULL WAVE, 60 HZ, 1.0 mm FOCAL SPOT RADIOGRAPHIC EXPOSURE CHART 1-2
1-2 SINGLE PHASE, FULL WAVE, 60 HZ, 2.0 mm FOCAL SPOT RADIOGRAPHIC EXPOSURE CHART 1-2
1-3 SINGLE PHASE, FULL WAVE, 60 HZ, 1.0 mm FOCAL SPOT FILAMENT EMISSION CHARTS 1-3
1-4 SINGLE PHASE, FULL WAVE, 60 HZ, 2.0 mm FOCAL SPOT FILAMENT EMISSION CHARTS 1-3
1-5 SINGLE PHASE, FULL WAVE, 50 HZ, 1.0 mm FOCAL SPOT RADIOGRAPHIC EXPOSURE CHART 1-4
1-6 SINGLE PHASE, FULL WAVE, 50 HZ, 2.0 mm FOCAL SPOT RADIOGRAPHIC EXPOSURE CHART 1-4

2-1 SINGLE PHASE, FULL WAVE, 60 HZ, 0.6 mm FOCAL SPOT RADIOGRAPHIC EXPOSURE CHART 2-2
2-2 SINGLE PHASE, FULL WAVE, 60 HZ, 1.2 mm FOCAL SPOT RADIOGRAPHIC EXPOSURE CHART 2-2
2-3 SINGLE PHASE, FULL WAVE, 60 HZ, 0.6 mm FOCAL SPOT FILAMENT EMISSION CHARTS 2-3
2-4 SINGLE PHASE, FULL WAVE, 60 HZ, 1.2 mm FOCAL SPOT FILAMENT EMISSION CHARTS 2-3
2-5 SINGLE PHASE, FULL WAVE, 50 HZ, 0.6 mm FOCAL SPOT RADIOGRAPHIC EXPOSURE CHART 2-4
2-6 SINGLE PHASE, FULL WAVE, 50 HZ, 1.2 mm FOCAL SPOT RADIOGRAPHIC EXPOSURE CHART 2-4

LIST OF FIGURES

VOLUME II

FIGURE PAGE

CHAPTER 16 - MISCELLANEOUS

1-1 LAYOUT AND PARTS LIST FOR MOBILE CASSETTE HOLDER 1-1

2-1 LAYOUT FOR LATERAL CASSETTE/GRID HOLDER 2-1

3-1 LAYOUT FOR MCT SIZE-SENSING TRAY 3-1

4-1 LAYOUT FOR RADIATION SHIELD 4-1

LIST OF TABLES

VOLUME I

TABLE PAGE

CHAPTER 1 - GENERAL

3-1 LUBRICATION SPECIFICATIONS 3-1

CHAPTER 2 - INSTALLATION

1-1 SHIPPING CRATE CONTENTS 1-5

2-1 TRANSPORT DEVICE ASM 2-3

CHAPTER 3 - CALIBRATION

2-1 KVP COMPENSATION 2-13
2-2 MINIMUM EXPOSURE TIME REQUIREMENTS
AT SELECTED DISTANCES 2-19
2-3 KVP COMPENSATION WITH NON-INVASIVE METERS 2-21
2-4 TOLA ADJUSTMENTS 2-31
2-5 FILAMENT ADJUSTMENT POTS 2-47

5-1 LOGIC CHART 5-10

6-1 PHANTOM THICKNESS VS. KVP SETTING 6-9

CHAPTER 4 - TROUBLESHOOTING

NO TABLES

CHAPTER 5 - OPERATION

5-1 RESULTS OF WHOLE BODY EXPOSURE TO X-RADIATION 5-2
5-2 ESTIMATED DOSES FOR VARYING DEGREES OF INJURY 5-3

6-1 BASIC TECHNIQUES 6-2
6-2 GRID CONVERSION FACTORS 6-4
6-3 APPROXIMATE ANATOMICAL KVP RANGE 6-5

CHAPTER 6 - MXT-350 GENERATOR

2-1 AUTOTRANSFORMER TERMINAL VOLTAGES 2-3
2-2 GENERATOR CABLE FUNCTIONS 2-6
2-3 CIRCUIT BREAKER FUNCTIONS 2-7

LIST OF TABLES

VOLUME I

TABLE PAGE

CHAPTER 6 - MXT-350 GENERATOR (continued)

3-1 LINE SET ADJUSTMENTS 3-2

5-1 PARTS LIST FOR 5785.234.01
MXR-350 CONTROL 5-5
5-2 PARTS LIST FOR 5184.234.03
MXR-350 AUX TECHNIQUE PANEL ASM 5-13
5-3 PARTS LIST FOR 5184.234.0310
MXR-350 ION CHAMBER PKUP & DENSITY 5-16
5-4 PARTS LIST FOR 5184.234.0320
MXR-350 SPOTFILM CHANGEOVER PCB 5-20
5-5 PARTS LIST FOR 5184.234.04
MXR-350 MA TECH SELECT SWITCH ASM 5-23
5-6 PARTS LIST FOR 5184.234.0410
MXR-350 ION CHAMBER POWER-RESET-FIELD SWITCH 5-26
5-7 PARTS LIST FOR 5184.234.0501
MXR-350 FLUORO MA CONTROL BOARD ASM 5-29
5-8 PARTS LIST FOR 5184.234.06
MXR-350 TIMER SAFETY SWITCH ASM 5-32
5-9 PARTS LIST FOR 5184.234.0601
MXR-350 60 HZ IMPULSE TIMER RSTR ASM 5-35
5-10 PARTS LIST FOR 5184.234.0690
MXR-350 UNIVERSAL TOLA RESISTOR ASM 5-38
5-11 PARTS LIST FOR 5184.234.0698
MXR-350 UNIVERSAL BACKUP TIMER RESISTOR ASM 5-41
5-12 PARTS LIST FOR 5184.234.0699
MXR-350 50 HZ IMPULSE TIMER RESISTOR ASM 5-44
5-13 PARTS LIST FOR 5184.234.08
MXR-350 PREPARE/EXPOSE PANEL ASM 5-47
5-14 PARTS LIST FOR 5184.234.09
MXR-350 FLUORO KVP METER SHUNT ASM 5-50
5-15 PARTS LIST FOR 5184.234.10
MXR-350 FLUORO EXPOSURE INDCTR ASM 5-53

LIST OF TABLES

VOLUME I

TABLE PAGE

CHAPTER 6 - MXT-350 GENERATOR (continued)

5-16 PARTS LIST FOR 5184.234.11
MXR-350 SFD PREP DELAY RELAY ASM 5-56
5-17 PARTS LIST FOR 5184.234.12
MXR-350 SINGLE PHASE IMPULSE TIMER ASM 5-59
5-18 PARTS LIST FOR 5184.234.19
MXR-350 FILAMENT DRIVE TRANSISTOR ASM 5-63
5-19 PARTS LIST FOR 5184.234.2901
MXR-350 24VDC EXPOSURE END BUZZ ASM 5-66
5-20 PARTS LIST FOR 5281.234.02
MXR-350 TIMER SWITCH ASM 5-69
5-21 PARTS LIST FOR 5284.234.1102
MXR-350 235A 800V IMPULSE TIMER/CONTACTOR 5-71
5-22 PARTS LIST FOR 5284.234.15
MXR-350 3P FILAMENT RESISTOR PNL ASM 5-73
5-23 PARTS LIST FOR 5285.234.01
MXR-350 3P FILAMENT DRIVE COOLING ASM 5-76
5-24 PARTS LIST FOR 5285.234.02
CONSTANT VOLTAGE TRANSFORMER ASM 5-78
5-25 PARTS LIST FOR 5285.234.03
MXR-350 RESISTOR PANEL ASM 5-80
5-26 PARTS LIST FOR 5286.234.04
AUX PWR SUPPLY 50/60 HZ XFMR ASM 5-82
5-27 PARTS LIST FOR 5286.234.05
FIL. XFMR SUPPLY ASM 50/60 HZ 5-84
5-28 PARTS LIST FOR 5485.234.01
MXR-350 TAP SWITCHES PANEL ASM 5-86
5-29 PARTS LIST FOR 5585.234.02
MXR-350 CONTACTOR PANEL ASM 5-88

LIST OF TABLES

VOLUME I

TABLE PAGE

CHAPTER 6 - MXT-350 GENERATOR (continued)

5-30 PARTS LIST FOR 6184.234.0803
MXR-350 MAS METER CURRENT INTEGRATOR ASM 5-91
5-31 PARTS LIST FOR 6284.234.01
MXR-350 UNIVERSAL TOLA ASSEMBLY 5-95
5-32 PARTS LIST FOR 6284.234.02
MXR-350 AUXILIARY RELAY PANEL ASM 5-99
5-33 PARTS LIST FOR 6284.234.03
MXR-350 KVP COMPENSATION PANEL ASM 5-102
5-34 PARTS LIST FOR 6284.234.04
MXR-350 EXPOSURE INTERLOCK PANEL ASM 5-105
5-35 PARTS LIST FOR 6284.234.0803
MXR-350 BACKUP TIMER PANEL ASM 5-109
5-36 PARTS LIST FOR 6284.234.09
MXR-350 ROTOR CONTROL WITH PHOTOTRANSISTORS 5-113
5-37 PARTS LIST FOR 6284.234.1009
MXR-350 CONSTANT CURRENT FILAMENT CONTROL ASM 5-118
5-38 PARTS LIST FOR 6284.234.11
MXR-350 SCR CONTACTOR-TIMER INTERFACE 5-123
5-39 PARTS LIST FOR 6284.234.12
MXR-350 MA-KVP-LINE METER SHUNT ASM 5-127
5-40 PARTS LIST FOR 6584.234.01
MXR-350 RELAY MATRIX ASM 5-130
5-41 PARTS LIST FOR 5184.323.02
75 KVP PLUG-IN RECTIFIER ASM 5-133
5-42 PARTS LIST FOR 5484.323.02
PLUG-IN HV DIODE BRIDGE ASM 5-136
5-43 PARTS LIST FOR 6360.009
150 KV PLUG-IN RECTIFIER ASM 5-138
5-44 PARTS LIST FOR 5786.323.03
MILITARY 2-TUBE HV TRANSFORMER TOP ASM 5-140
5-45 PARTS LIST FOR 6632.300
TRANSFORMER ASSEMBLY 5-143

LIST OF TABLES

VOLUME II

TABLE PAGE

CHAPTER 7 - MXT-90/15 TABLE

4-1 PARTS LIST FOR 5282.062.01 MILITARY TABLE HE TERMINAL ASM 4-4
4-2 PARTS LIST FOR 5284.062.04 POWER TOP LONG DRIVE PNL ASM 4-6
4-3 PARTS LIST FOR 5284.062.1801 MXT 90/15 TABLE 5 FUNCTION CONTROL SWITCH 4-9
4-4 PARTS LIST FOR 5536.062.02 MILITARY TABLE/EUREKA TOWER CWT ASM 4-12
4-5 PARTS LIST FOR 5736.060.04 AINSWORTH LONGITUDINAL CARRIAGE ASM 4-14
4-6 PARTS LIST FOR 5736.060.05 AINSWORTH LATERAL CAR ASM 4-19
4-7 PARTS LIST FOR 5736.062.02 TABLE BODY ASM 4-27
4-8 PARTS LIST FOR 5736.062.03 MILITARY R-F TABLE FRNT SKIRT ASM 4-32
4-9 PARTS LIST FOR 5736.062.04 MILITARY BEARING TOP OUTER FRAME ASM 4-34
4-10 PARTS LIST FOR 5736.062.06 MILITARY R-F TABLE LEG ASM 4-36

LIST OF TABLES

VOLUME II

TABLE PAGE

CHAPTER 7 - MXT-90/15 TABLE (continued)

4-11 PARTS LIST FOR 5736.062.07
MILITARY TABLE/EUREKA ELEVATOR ASM 4-42
4-12 PARTS LIST FOR 5736.062.08
MILITARY TABLE/EUREKA TOWER ASM 4-45
4-13 PARTS LIST FOR 5736.062.09
MILITARY BEARING TOP INNER FRAME ASM 4-48
4-14 PARTS LIST FOR 5536.009.06
TOP DRIVE CONTROL SW ASM 4-52
4-15 PARTS LIST FOR 5236.500.02
PATIENT HANDGRIP 4-55
4-16 PARTS LIST FOR 5436.504.02
UROLOGICAL RIGHT-HAND KNEE CRUTCH 4-57
4-17 PARTS LIST FOR 5436.504.03
UROLOGICAL LEFT-HAND KNEE CRUTCH 4-59
4-18 PARTS LIST FOR 5536.500.01
COMPRESSION BAND DEVICE 4-61
4-19 PARTS LIST FOR 5536.504.01
ADJUSTABLE SHOULDER REST 4-64
4-20 PARTS LIST FOR 5536.504.02
FOOTREST 4-67
4-21 PARTS LIST FOR 9491.201
VACUUM HEAD CLAMP 4-69

CHAPTER 8 - TUBESTAND

4-1 PARTS LIST FOR 5536.101.01
CTC MAIN FRAME ASM 4-4
4-2 PARTS LIST FOR 5536.101.02
CTC VERTICAL & LATERAL CARRIAGE ASM 4-6
4-3 PARTS LIST FOR 5536.101.05
CTC HORIZONTAL CARRIAGE ASM 4-9
4-4 PARTS LIST FOR 5536.101.06
CTC VERTICAL COLUMN ASM 4-11
4-5 PARTS LIST FOR 6810.100
MILITARY FLOOR-MOUNTED TUBESTAND ASM 4-14

LIST OF TABLES

VOLUME II

TABLE PAGE

CHAPTER 9 - AUXILIARY BOX

2-1 PARTS LIST FOR 5785.062.01 TABLE TUBESTAND AUXILIARY BOX ASM 2-4
2-2 PARTS LIST FOR 6284.062.03 MXT 90/15 MAG LOCK POWER SUPPLY PCB 2-8
2-3 PARTS LIST FOR 6284.062.05 MXT 90/15 MOTOR CARRIAGE DRIVE ASM 2-11
2-4 PARTS LIST FOR 6284.062.06 MXT 90/15 VARI-SPEED TILT CNTRL PCB 2-14
2-5 PARTS LIST FOR 6284.062.07 MXT 90/15 TABLE TILT CONTROL PCB 2-17

CHAPTER 10 - SPOT FILM DEVICE

7.1 SYMPTOMS, CAUSES AND CURES FOR CHASSIS SENSORS 7-5

10.1 BILL OF MATERIALS EXT 950 POWER SUPPLY, 70-10416 10-3
10.2 BILL OF MATERIALS EXT Z80 INTERFACE PCB ASSEMBLY, 70-08077 10-6
10.3 BILL OF MATERIALS EXT Z80 INTERFACE BOARD ASSEMBLY, 70-08078 10-12
10.4 BILL OF MATERIALS EXT Z80 INTERFACE PCB ASSEMBLY, 70-08079 10-17

CHAPTER 11 - UNDER-TABLE COLLIMATOR

3-1 CURRENT VX. SID IN OHMS/IN. 3-12

5-1 MINIMUM BEAM QUALITY REQUIREMENTS 5-4
5-2 ALUMINUM EQUIVALENT OF PRIMARY BEAM TOTAL FILTRATION 5-5
5-3 HIGHEST DESIGN OPERATING RANGE 5-7
5-4 HALF-VALUE LAYERS AS A FUNCTION OF FILTRATION AND TUBE POTENTIAL FOR DIAGNOSTIC UNITS 5-7

8-1 TUBE MOUNTING INFORMATION 8-3

LIST OF TABLES

VOLUME II

TABLE PAGE

CHAPTER 11 - UNDER-TABLE COLLIMATOR (continued)

9-1 BILLS OF MATERIAL UNDER-TABLE LOGIC PCB ASSEMBLY, 70-08084 . . . 9-3
9-2 BILLS OF MATERIAL FSE DRIVER PCB ASSEMBLY, 70-08083 . . . 9-8

CHAPTER 12 - OVER-TABLE COLLIMATOR

2-1 CASSETTE SIZES VS. OUTPUT VOLTAGE . . . 2-5

3-1 LINEAR II LOGIC CHART . . . 3-9

6-1 MINIMUM BEAM QUALITY REQUIREMENTS . . . 6-17
6-2 ALUMINUM EQUIVALENT OF PRIMARY BEAM TOTAL FILTRATION . . 6-17
6-3 HIGHEST DESIGN OPERATING RANGE . . . 6-19
6-4 HALF-VALUE LAYERS AS A FUNCTION OF FILTRATION AND TUBE POTENTIAL FOR DIAGNOSTIC UNITS . . . 6-19

8-1 TUBE MOUNTING INFORMATION . . . 8-2
8-2 SIGNAL NAMES DEFINITION . . . 8-3
8-3 40-CONDUCTOR CABLE COLOR CROSS-REFERENCE . . . 8-4
8-4 LINEAR II LOGIC CHART . . . 8-5
8-5 TILTING WALL BUCKY INTERFACE . . . 8-6

10-1 BILLS OF MATERIAL - LOGIC PCB ASSEMBLY (70-08080) . . . 10-5
10-2 BILLS OF MATERIAL - MASTER PCB ASSEMBLY (70-08081) . . . 10-9
10-3 BILLS OF MATERIAL - LAMP & DRIVER PCB ASM (70-08082) . . . 10-13

LIST OF TABLES

VOLUME II

TABLE PAGE

CHAPTER 13 - AUTOMATIC EXPOSURE CONTROL

5.1 KVP COMPENSATION SETTINGS 5-7

7.1 PARTS LIST 60899B INPUT AMPLIFIER BOARD 7-18
7.2 PARTS LIST 60900F LOGIC CONTROL BOARD 7-19
7.3 PARTS LIST 60907D KVP COMPUTER BOARD 7-20
7.4 PARTS LIST 60916C POWER SUPPLY BOARD 7-23
7.5 PARTS LIST 61017C DISPLAY BOARD A3365-G 7-25
7.6 PARTS LIST 60917C PRE-AMP,3-FIELD IONIZATION CHAMBER 7-27
7.7 PARTS LIST 60940D PRE-AMP,1-FIELD IONIZATION CHAMBER 7-29

CHAPTER 14 - IMAGE INTENSIFIER

4-1 PARTS LIST FOR 5536.822.04
MIL 6" MIRROR/LENS SUPPORT MNT ASM 4-3
4-2 PARTS LIST FOR 5536.822.05
6" EUREKA/THOMSON OPTICS SPRT ASM 4-6

CHAPTER 15 - X-RAY TUBES

NO TABLES

CHAPTER 16 - MISCELLANEOUS

2-1 PARTS LIST FOR LATERAL CASSETTE/GRID HOLDER 2-2

3-1 PARTS LIST FOR MCT SIZE-SENSING TRAY 3-2

4-1 PARTS LIST FOR RADIATION SHIELD 4-2

CHAPTER 1

GENERAL

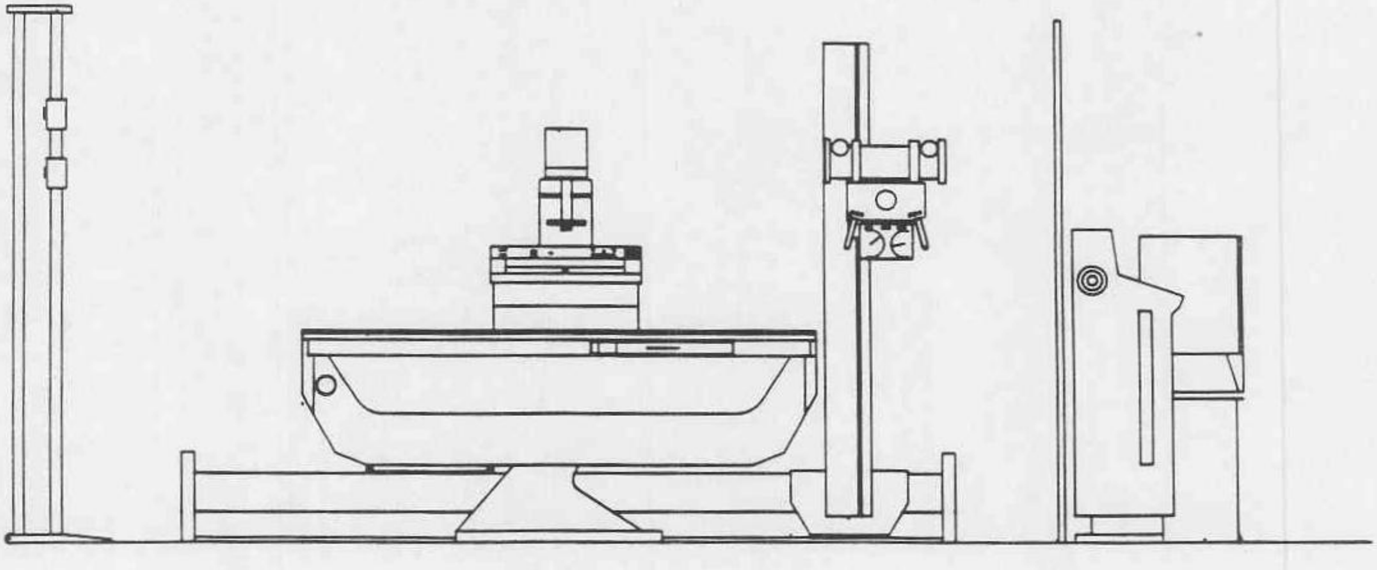

TABLE OF CONTENTS
CHAPTER 1 - GENERAL

SECTION NUMBER	DESCRIPTION	PAGE NUMBER
SECTION 1 - INTRODUCTION		1-1
1.1	HOW TO USE THIS MANUAL	1-1
1.2	SCOPE	1-1
1.3	SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES	1-2
1.4	MAXIMUM PERMISSIBLE DOSE	1-3
1.5	CDRH COMPLIANCE	1-3
SECTION 2 - SPECIFICATIONS		2-1
2.1	GENERATOR SPECIFICATIONS	2-1
2.2	TABLE SPECIFICATIONS	2-3
2.3	TUBESTAND, SPECIFICATIONS	2-4
SECTION 3 - STORAGE		3-1
3.1	GENERAL	3-1
3.2	LUBRICATION SPECIFICATIONS	3-1
3.3	STORAGE INFORMATION OF SPOT FILM DEVICE	3-2
3.4	STORAGE INFORMATION OF THE IMAGE INTENSIFIER SYSTEM	3-2

LIST OF FIGURES

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
1-1	CS-8952 X-RAY SYSTEM	1-4
1-2	HARD WALL SHELTER CONFIGURATION	1-5
1-3	A TYPICAL HOSPITAL CONFIGURATION	1-6

LIST OF TABLES

TABLE NUMBER	DESCRIPTION	PAGE NUMBER
3-1	LUBRICATION SPECIFICATIONS	3-1

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CHAPTER 1 - GENERAL

SECTION 1 - INTRODUCTION

1.1 HOW TO USE THIS MANUAL

Due to its large size, this manual is divided into two volumes. At the beginning of each volume is a complete Table of Contents covering both volumes. The Table of Contents is followed by a complete List of Figures and a complete List of Tables. These make a good "road map" to find desired information.

The x-ray system consists of several components, including the generator, table, tubestand, etc. The first five chapters (in Volume I) address overall system operations such as installation, calibration, operation, that are not specific to any component.

All the rest of the chapters in Volume I and Volume II are devoted to specific sub-systems. Each of these chapters contains assembly drawings, parts lists and schematics, as well as detailed information on maintenance for that component.

Each chapter is divided into numbered sections, beginning with "1". Sections are divided into sub-sections, whose number consists of the section number plus the next sequential sub-section number (1.1, 1.2, ...).

All pages are numbered with the section number plus a sequential page number (Page 1-1, Page 1-2, ...). In addition to the page number, the bottom of each page has its chapter name. Also on the bottom of the page is a 4-digit code representing the revision date of that page.

Figures and Tables are numbered in a similar manner.

1.2 SCOPE

This text provides the medical equipment repairer with complete maintenance information for the CS-8952 Field Deployable Radiographic/Fluoroscopic X-ray System.

The Military Field Deployable X-ray System (CS-8952) is designed to Commercial Standards for use by the Armed Forces in hard wall shelters and other field environments. It is equally adaptable to a hospital or clinic situation if that is to be the preferred use.

The system is a complete radiographic/fluoroscopic system capable of performing conventional fluoroscopic/spot film procedures at any table angulation, and

1.2 SCOPE (continued)

radiographic procedures including vertical radiography to cassette tray, table top, or floor, horizontal radiography to a mobile cassette holder, and cross-table radiography.

By utilizing separate under-table and over-table x-ray tube positioning systems, procedures types may be intermixed, yet rapidly performed because procedure setup time is minimized.

The system includes a radiographic/fluoroscopic tilt table, an overhead tube support with a full range of motions, an electronically controlled spot film device, a six-inch image intensifier with mirror viewer, and a single phase x-ray power unit. Baseplates for the hard wall shelter installation and equipment handling devices are also supplied. The table and overhead tube support are provided with leveling screws for installation on uneven surfaces.

The Military Field Deployable X-ray System is suitable for installation on any reasonably level hard surface. It will provide full capabilities either in a field or hospital setting. Patient or casualty throughput will be significantly higher than with a single tube system which requires reconfiguration for various porcedures. The single phase power unit is adaptable to a wide range of incoming power sources, 50 Hz or 60 Hz, both single and three phase, since single phase can be derived from three phase power systems. The system is capable of being unpacked and installed by four personnel in less than eight (8) hours with standard tools and test equipment.

The system also includes a full set of accessories, including footstep, leg supports, mobile cassette holder, cross-table cassette holder, shoulder supports, compression band, head clamp, and detachable hand grips

1.3 SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES

One of the most important considerations in x-ray work is protection against the hazards of x-ray radiation. The x-ray equipment itself does not pose any danger but careless and improper usage does. It is essential that all operator and service personnel be properly informed on this matter. Those responsible for the operation and maintenance of this x-ray equipment must fully understand the dangers, be familiar with the characteristics of x-ray radiation and high voltage, and become thoroughly acquainted with the instructions in this manual.

The following guidelines have been laid down for personal safety:

1. Never expose a human for demonstration purposes only.

2. Never remain in a radiographic room while an exposure is in progress. Approximately 0.1% of the useful beam is scattered perpendicular to the beam at a distance of 1 meter from the patient.

1.3 SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES (continued)

3. Patients should rarely be restrained for radiography. Many efficient devices are available to achieve the required results, in addition to the technologists ingenuity.

4. If a patient must be held, it should be done by a person not habitually exposed to ionizing radiation, whenever possible. In any case, this person must be protected by a lead apron and lead gloves.

5. Use an appropriate personnel film badge monitoring service and insist that all personnel are assigned a film badge, and wear them correctly.

6. During fluoroscopy, wear a protective apron and, when not actually assisting, stand in the control booth or behind the radiologist.

7. Periodically check protective aprons and gloves for cracks by a radiographic test using intensifying screens and exposure factors of 100 kVp, 10 mAs at a 100 cm (40-inch) focus-to-film distance.

WARNING

THE GENERATOR CALIBRATION PROCEDURE REQUIRES THE PRODUCTION OF X-RAYS AND MANDATES THE STRICT OBSERVANCE OF ALL SAFETY PRECAUTIONS, INCLUDING THE USE OF PROTECTIVE DEVICES.

HIGH VOLTAGE PRESENT. OBSERVE ALL SAFETY PRECAUTIONS AND PRACTICES.

1.4 MAXIMUM PERMISSIBLE DOSE

Many studies of the effects of x-ray radiation have been done to determine a "Maximum Permissible Dose". Conclusive evidence of what is a safe amount of radiation has remained elusive.

A safe rule to follow is "As Low As Reasonably Achievable" (ALARA). Always take all reasonable precautions to reduce radiation exposure as much as possible to patients, physicians, technicians, etc. at all times.

1.5 CDRH COMPLIANCE

All components of the x-ray system conform to the applicable requirements of the Center for Devices and Radiological Health (CDRH), Department of Health and Human Services, 21 CFR, Chapter 1, Subchapter J, at the time of manufacture.

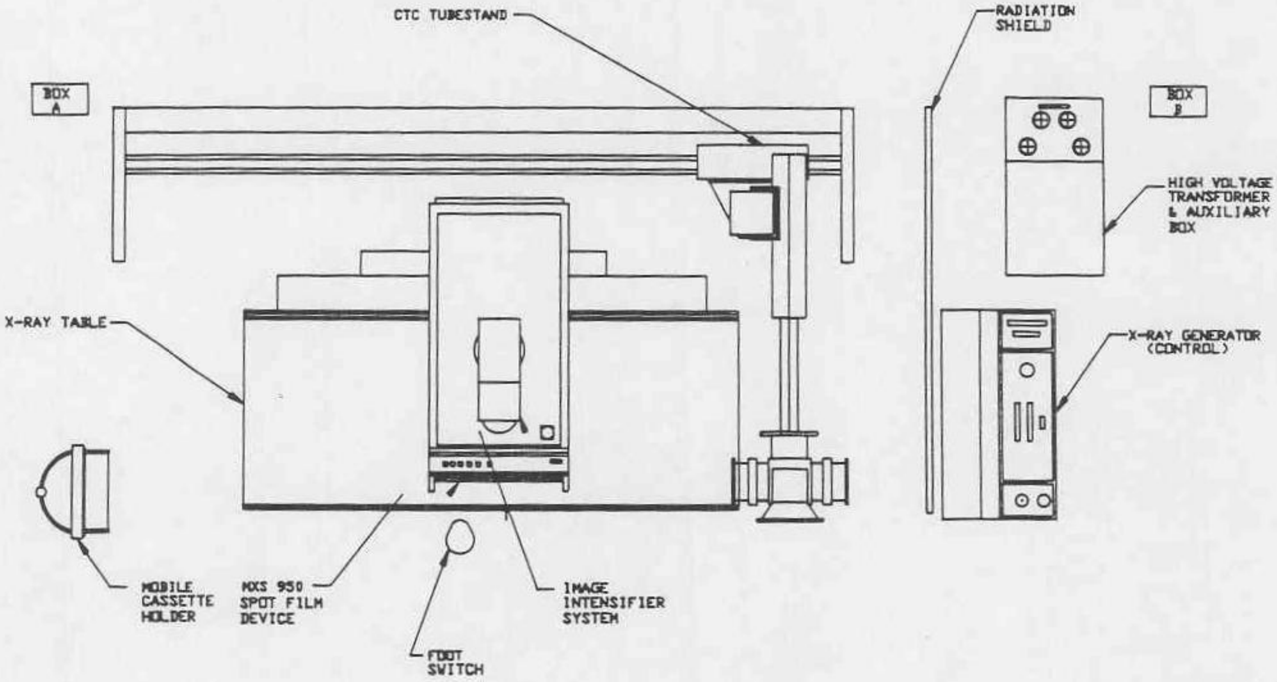

CTC TUBESTAND
RADIATION SHIELD
BOX A
BOX B
HIGH VOLTAGE TRANSFORMER & AUXILIARY BOX
X-RAY TABLE
X-RAY GENERATOR (CONTROL)
MOBILE CASSETTE HOLDER
MXS 950 SPOT FILM DEVICE
IMAGE INTENSIFIER SYSTEM
FOOT SWITCH

FIGURE 1-1 CS-8952 X-RAY SYSTEM

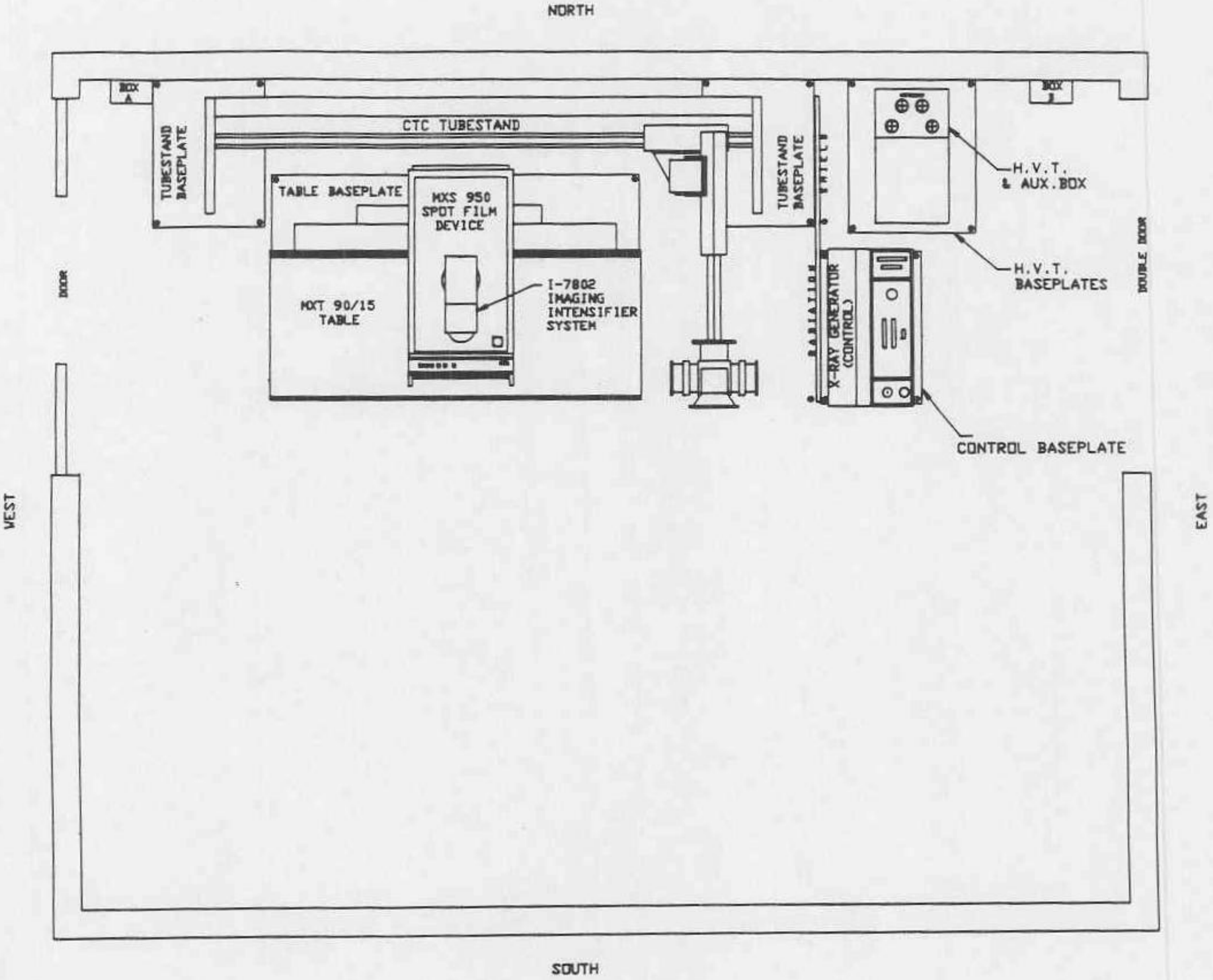

NORTH
BOX A
TUBESTAND BASEPLATE
CTC TUBESTAND
TABLE BASEPLATE
MXS 950 SPOT FILM DEVICE
I-7802 IMAGING INTENSIFIER SYSTEM
MXT 90/15 TABLE
TUBESTAND BASEPLATE
RADIATION SHIELD
X-RAY GENERATOR (CONTROL)
BOX B
H.V.T. & AUX.BOX
H.V.T. BASEPLATES
CONTROL BASEPLATE
DOUBLE DOOR
DOOR
WEST
EAST
SOUTH

FIGURE 1-2 HARD WALL SHELTER CONFIGURATION

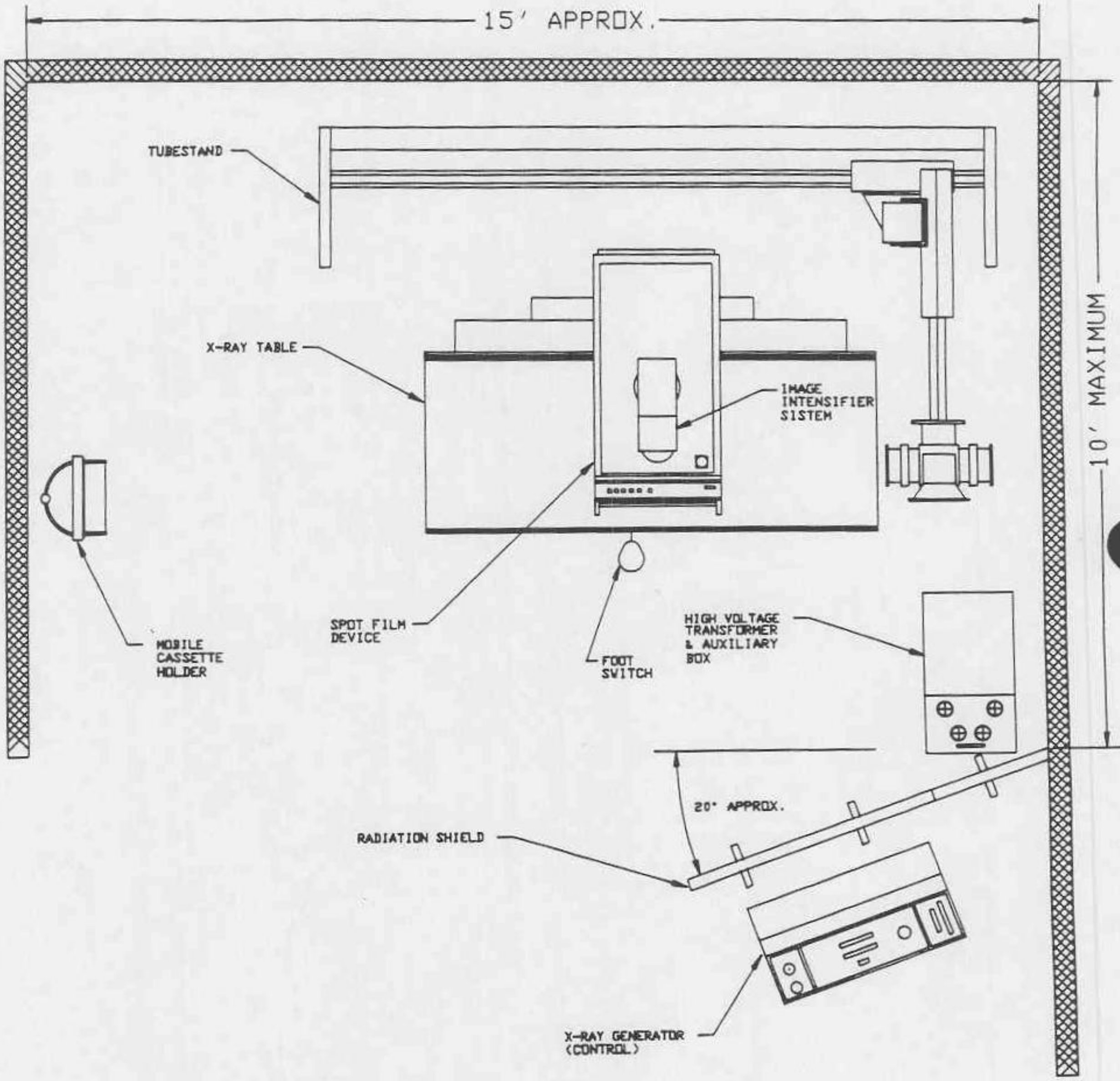

15' APPROX.
TUBESTAND
X-RAY TABLE
IMAGE INTENSIFIER SISTEM
10' MAXIMUM
MOBILE CASSETTE HOLDER
SPOT FILM DEVICE
FOOT SWITCH
HIGH VOLTAGE TRANSFORMER & AUXILIARY BOX
20° APPROX.
RADIATION SHIELD
X-RAY GENERATOR (CONTROL)

FIGURE 1-3 A TYPICAL HOSPITAL CONFIGURATION

SECTION 2 - SPECIFICATIONS

2.1 GENERATOR SPECIFICATIONS

- **PHYSICAL DIMENSIONS**

Main Control	48-1/2"H X 33"W X 18"D (1232mm X 838mm X 457 mm)
High Voltage Transformer	26"H X 29"L X 16"W (660mm X 737mm X 406mm)

Shipping Weight (approximate):

Main Control	484 lb.
High Voltage Transformer	706 lb.

- **ELECTRICAL**

Power Requirements	240VAC (nominal), 132A., 50/60Hz
Voltage Range	190 - 270VAC
Output Power	
Maximum	(300mA at 150kVp) 45,000W.

2.1 GENERATOR SPECIFICATIONS (continued)

- **OPERATIONAL**

mA Selection	
Small Focal Spot	25mA, 50mA, 100mA
Large Focal Spot	100mA, 150mA, 200mA, 300mA
kVp Selection	
Total Range	40 - 150kVp
Radiographic	kVp Major 10KV steps kVp Minor 1.7KV steps (approximately)
Fluoroscopic	kVp continuously variable from 55KV to 125KV
Time Selection	(seconds - 60Hz) 1/120, 1/60, 1/40, 1/30, 1/24, 1/20, 1/15, 1/12, 1/10, 2/15, 1/6, 1/5, 1/4, 1/3, 2/5, 1/2, 2/3, 4/5, 1, 1-1/2, 2, 3, 4, 6, 8
Time Selection	(seconds - 50Hz) 1/100, 1/50, 3/100, 1/25, 1/20, 3/50, 2/25, 1/10, 3/25, 3/20, 1/5, 1/4, 3/10, 2/5, 1/2, 3/5, 4/5, 1, 1-1/2, 2, 3, 4, 6, 8

2.2 TABLE SPECIFICATIONS

2.2.1 PHYSICAL DIMENSIONS

2.2.1.1 TABLE

Table Base	32-1/4" x 34-5/8" (820 mm X 880 mm)
Table Body	30" x 81" (762 mm X 2,057 mm)
Table Top Height	34-1/2" (876.3 mm - Table horizontal)

2.2.1.2 GRID CABINET

Dimensions	23"L X 18-1/2"W (584.2 mm x 470mm)
Grid Type	Fixed, 150 line

2.2.2 ELECTRICAL

Power Requirements	115VAC, 8 Amp., 50/60 Hz.

2.2.3 SHIPPING WEIGHT

2264 lb. (1027 KG)

2.2.4 OPERATIONAL ENVIRONMENT

Temperature Range	32°F - 122°F (0°C - 50°C)
Humidity Range	0% - 100%

2.2.5 TABLE OPERATIONAL CHARACTERISTICS

Tilt	
Range	+88° to -12°
Rate	4.5° per second
Focal Point-to-Table top	17" +/- 1/4" (457 mm +/- 6 m) distance
Focal Point-to-shutter	
Upper Shutter	9.22" +/- 1/4" (234 mm +/- 6 mm) distance
Lower Shutter	8.58" +/- 1/4" (217.1 mm +/- 6 mm) distance

2.2.5 TABLE OPERATIONAL CHARACTERISTICS (continued)

Focal Point-to-floor	27 3/16" to 64 3/16" (690 mm to 1630 mm - Table distance vertical)
Tube Transverse travel	5 3/4" (146 mm) center to front, plus 5 3/4" center to back (11 1/2" - 292 mm, total)
Table Longitudinal travel	30" (762 mm) from center to head end and 30" from center to foot end (60" or 1524 mm, total)
Maximum patient weight	300 pounds (136 KG)

2.3 TUBESTAND, SPECIFICATIONS

2.3.1 TUBESTAND PHYSICAL

DIMENSIONS	Length- 120 1/2" Width- 54" ± 8" Height- 86 172"

WEIGHT

Tubestand (structure)	1035 lbs
Tubestand (assembly)	1100 lbs

TRAVEL DIMENSIONS

Longitudinal	101"
Vertical	60"
Lateral	16"
Column Rotation	± 90°
Tube Rotation	± 180°
Tube Pitch	30° forward 20° backward

2.3.2 ELECTRICAL POWER REQUIREMENTS

115VAC 50 - 60Hz (from Auxiliary Cabinet).

SECTION 3 - STORAGE

3.1 GENERAL

The system can be stored indoors or outdoors, if it is protected from rain, at a temperature of minus 67° F (minus 55° C) to 167° F (75° C) and at a relative humidity approaching saturation point. If these limits are exceeded for more than 24 hours, the system must be allowed to acclimate for at least 24 hours before power is applied.

CAUTION

BEFORE TURNING THE SYSTEM OVER FOR USE, PERFORM THE DAILY PRE-OPERATIONAL SYSTEM CHECK, LOCATED IN THE OPERATOR'S SECTION OF THIS MANUAL, CHAPTER 5.

3.2 LUBRICATION SPECIFICATIONS

TILT DRIVE GEAR REDUCER:
TABLE TOP LONGITUDINAL DRIVE GEAR REDUCER:

TABLE 3-1 LUBRICATION SPECIFICATIONS

OIL PRODUCT	MANUFACTURER
Shell Valvata Oil No. J-78	Shell Oil Company
Nacoma 72	Shell Oil Company
Mobil Cylinder Oil No. 600W	Mobil Oil Corp.
Mobil Compound DD	Mobil Oil Corp.

Specifications

Type	High Grade, Compound
Viscosity	125 to 150 seconds, 210° F.
AGMA Grade	No. 7, Compound

In an emergency, SAE No. 140 gear oil may be used until the specified oil is obtained.

Worm gear oil is very sticky. It is most easily handled with the aid of a pump or gun.

BEARINGS:

Use a light grade of machine oil, sparingly, on all bearings throughout the Spot Film Device and tower assemblies.

3.3 STORAGE INFORMATION OF SPOT FILM DEVICE

The spot film device (SFD) can be stored for as long as eight years in environments whose temperature and relative humidity do not exceed 85° F (30° C) and 70%. Exceeding these limits may cause deterioration of the cassette carriage drive belts.

In addition, tension on the drive belts may distort them when they are unused for an extended period of time. Therefore,it is recommended that the tension be relaxed on all belts if the SFD is to be stored for more than six months. Do this by loosening both tension idler pulleys inside the SFD.

Prepare the SFD for storage by repacking it in its original shipping material whenever possible. If the original packing material is not available, use a heavy-duty corrugated cardboard carton or, preferably, a wooden crate whose inside dimensions exceed those of the SFD by at least 15% in all directions.

Before placing the SFD in the container, cushion the bottom with no less than 2" (50mm) of foam padding, or other similar material. After centering the unit in the container, fill all empty spaces, including the top, with enough padding to prevent shifting. Finally, use a high quality tape to seal the container or nail it shut, as appropriate. Masking tape is NOT recommended with cardboard cartons because its adhesive often fails as it ages. **Avoid stacking heavy items on top of the container during storage and make sure that the equipment is protected against damage.**

3.4 STORAGE INFORMATION OF THE IMAGE INTENSIFIER SYSTEM

When the image intensifier system is not in use for an extended period of time or when it is being stored,it is necessary to "season" the Intensifier tube. "Seasoning" is done by applying electrical current to the intensifier tube for a 24 hour period.

If the tube has been installed and has been idle for an extended period of time, i.e., 4 to 6 months, power can be applied to it through the spot film device. Check to make sure the power supply cord is connected to the spot film device control panel and then turn power on and let it run for 24 hours before operating.

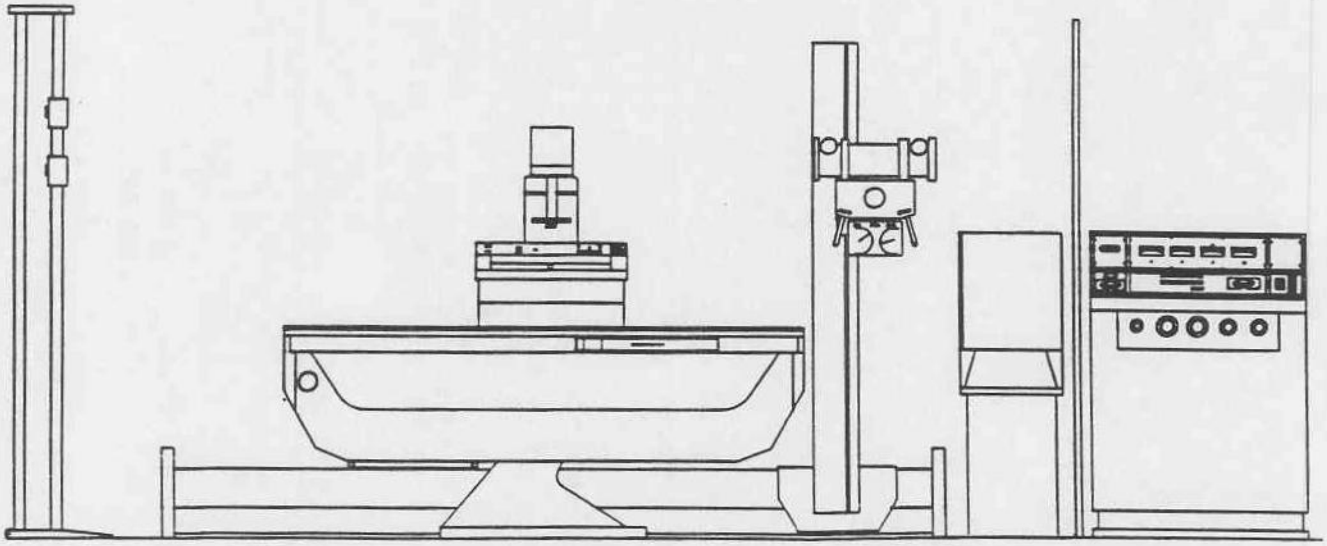
If the tube is being stored, it is recommended that the tube be "seasoned" every 6 months. In its uninstalled state, power to the tube can be applied by using the auxillary power cord supplied with the system. The auxillary cord is equipped with a bulkhead receptacle which will accept the bulkhead plug on the power supply cord. Once the auxillary cord and the power supply cord are connected, the auxillary cord can be plugged into any 115V line. Allow current to run through the tube filament for 24 hours.

THE CONTENTS OF THESE PAGES BELONG IN CHAPTER 2

updated April 92
RH Barnett

CHAPTER 2

INSTALLATION



CHAPTER 2 - INSTALLATION

TABLE OF CONTENTS

SECTION PAGE

SECTION 1 - GENERAL

1.1 SCOPE 1-1
1.2 TOOLS REQUIRED 1-1
1.3 EQUIPMENT REQUIRED 1-5
1.4 CONTENTS OF SHIPPING CRATES 1-5
1.5 UNPACKING 1-5
1.6 DIRECTIONAL ASSIGNMENT NAMING CONVENTION USED 1-7
1.7 TRANSPORT DEVICE 1-8
1.8 MOVING THE TUBESTAND 1-11
1.8.1 MOUNTING THE TUBESTAND 1-11
1.9 MOVING THE TABLE 1-17
1.9.1 TABLE MOUNTING 1-22
1.9.2 TABLE WIRING CONNECTIONS 1-22
1.9.3 TABLE TOP REMOVAL 1-24
1.10 RADIATION SHIELD 1-26
1.11 MOVING GENERATOR COMPONENTS 1-28
1.11.1 MOUNTING THE GENERATOR 1-31
1.12 MOUNTING THE UNDER-TABLE COLLIMATOR AND X-RAY 1-33
1.13 MOUNTING THE SPOT FILM DEVICE AND IMAGE INTENSIFIER 1-37
1.14 ELECTRICAL CONNECTIONS 1-41
1.15 OVER-TABLE X-RAY TUBE INSTALLATION 1-41
1.15.1 OVER-TABLE COLLIMATOR INSTALLATION 1-45
1.16 LEVELING THE TABLE AND PLUMBING THE TOWER 1-46
1.17 TABLE OPERATIONAL CHECK 1-48

SECTION 2 - TRANSPORT DEVICE PARTS LIST

2.0 TRANSPORT DEVICE PARTS LIST 2-1

SECTION 3 - ISO-SHELTER SHIPPING FIXTURES

3.0 INSTALLATION OF SHIPPING FIXTURES IN ISO-SHELTER 3-1
3.1 BILLS OF MATERIAL FOR SHIPPING FIXTURES 3-1
3.2 TUBESTAND BASE PLUNGER ASSEMBLY 3-1
3.3 TUBESTAND UPPER LOCKING ASSEMBLY 3-4
3.4 TUBESTAND VERTICAL CARRIAGE PLUNGER ASSEMBLY 3-4
3.5 TUBESTAND BASE PLUNGER ASSEMBLY 3-5
3.6 TABLE HEAD END & FOOT END SUPPORT ASSEMBLY 3-5
3.7 MOUNT SHIPPING FIXTURE POSTER TO ISO-SHELTER WALL 3-5

TABLE OF CONTENTS (continued)

SECTION PAGE

SECTION 4 - PREPARE ISO-SHELTER FOR USE

4.1 ISO-SHELTER PREPARATION 4-1
4.2 TABLE TOP REMOVAL 4-1
4.3 THE UNDER-TABLE COLLIMATOR AND X-RAY TUBE 4-1
4.4 TABLE PREPARATION 4-2
4.5 TUBESTAND PREPARATION 4-2
4.6 OVER-TABLE COLLIMATOR AND X-RAY TUBE 4-4
4.7 THE SPOT FILM DEVICE AND THE IMAGE INTENSIFIER 4-4

SECTION 5 - PREPARE ISO-SHELTER FOR TRANSPORT

5.1 REMOVAL OF THE IMAGE INTENSIFIER 5-1
5.2 REMOVAL OF THE SPOT FILM DEVICE 5-1
5.3 REMOVAL OF THE OVER-TABLE COLLIMATOR 5-2
5.4 REMOVAL OF THE OVER-TABLE X-RAY TUBE 5-3
5.5 TABLE TOP REMOVAL 5-3
5.6 SUB-TOP REMOVAL 5-3
5.7 REMOVAL OF THE UNDER-TABLE COLLIMATOR 5-5
5.8 REMOVAL OF THE UNDER-TABLE X-RAY TUBE 5-5
5.9 TABLE PREPARATION 5-6
5.10 TUBESTAND PREPARATION 5-7

LIST OF FIGURES

FIGURE PAGE

1-1 EQUIPMENT LAYOUT, OPERATIONAL MODE 1-2
1-2 EQUIPMENT LAYOUT, SYSTEM FREE STANDING 1-3
1-3 INSTALLATION IN AN EXPANDABLE ISO-SHELTER 1-4
1-4 INTEGRATED CONFIGURATION: TRANSPORT DEVICE 1-9
1-5 TRANSPORT DEVICE CRANE FORKS 1-10
1-6 TUBESTAND WITH CRANE FORKS IN THE SLOTS 1-12
1-7 VERTICAL CARRIAGE SHIPPING BRACKET 1-14
1-8 LONGITUDINAL CARRIAGE SHIPPING BRACKET 1-15
1-9 TRANSVERSE ARM LOCKING BOLT 1-16
1-10 TRANSPORT DEVICE: SEPARATED CONFIGURATION 1-18
1-11 TABLE SPRING LOADED CHECK 1-20
1-12 INSIDE TABLE VIEW, HEAD END, WITH CRANE FORK PINS 1-21
1-13 TABLE LATERAL CARRIAGE/FLUORO SHIPPING LOCK 1-23
1-14 TABLE TOP REMOVAL 1-25

LIST OF FIGURES (continued)

FIGURE PAGE

1-15 RADIATION SHIELD 1-27
1-16 TRANSPORT DEVICE WITH TRANSFORMER/AUXILIARY BOX 1-29
1-17 TRANSPORT DEVICE WITH MAIN CONTROL 1-30
1-18 SUGGESTED ISO-SHELTER FLOOR INSERT PATTERN 1-32
1-19 PANEL AND CABLE MOUNTING 1-34
1-20 UNDER-TABLE COLLIMATOR AND X-RAY TUBE MOUNTING 1-35
1-21 MOUNTING OVER-TABLE TUBE AND COLLIMATOR 1-36
1-22 MOUNTING OF SPOT FILM DEVICE 1-39
1-23 IMAGING INTENSIFIER SYSTEM PLACEMENT 1-40
1-24 SYSTEM LAYOUT, ISO-SHELTER 1-42
1-25 SYSTEM LAYOUT, FREESTANDING 1-43
1-26 ECCENTRIC BEARINGS FOR PLUMBING THE TABLE TOWER 1-47

2-1 TRANSPORT DEVICE ASSEMBLY, VIEW 1 2-2
2-2 TRANSPORT DEVICE ASSEMBLY, VIEW 2 2-2

3-1 TUBESTAND SHIPPING FIXTURES 3-3
3-2 TABLE SHIPPING FIXTURES, PART NUMBERS 3-6
3-3 TABLE SHIPPING FIXTURES, CALL-OUTS 3-8

4-1 TUBESTAND SHIPPING LOCKS 4-3

5-1 TABLE TOP SHIPPING PREPARATION 5-4
5-2 CONTAINER SHIPPING POSITIONS 5-8

LIST OF TABLES

TABLE PAGE

1-1 CHECK LIST FOR UNPACKING 1-6

2-1 TRANSPORT DEVICE ASSEMBLY 2-3

3-1 TUBESTAND ISO-SHELTER SHIPPING PARTS 3-2
3-2 TABLE ISO-SHELTER SHIPPING PARTS 3-7

SECTION 1 - GENERAL

1.1 SCOPE

This chapter provides instructions for the installation of the CS-8952 Field Deployable X-ray System. These instructions apply equally to all configurations (**FIGURES 1-1, 1-2,** and **1-3**) unless otherwise specified.

Information on the ISO-shelter shipping fixtures is also included in this chapter.

1.2 TOOLS REQUIRED

slotted screwdrivers
large screwdriver that can be used as a wedge
assorted sizes phillips screwdrivers
set open-end wrenches, 3/8" to 1"
set of allen wrenches, 1/16" to 5/8"
small ratchet set, 1/4" to 1/2"
large ratchet set, 7/16" to 1"
needle nosed pliers
50 foot-lb torque wrench
6" (150 mm) adjustable wrench
8" (200 mm) adjustable wrench
10" (260 mm) adjustable wrench
12" (300 mm) or longer spirit level
ISO-shelter insert mounting tool
5/8"-7/8" eccentric (bearing adjusting) wrench (Continental part # 4144.474.03)

file
wooden mallet
paper towels
denatured alcohol
grease pencil
protractor
tie wraps
tie wrap gun
tape measure
wire cutter
vice grip pliers
set of nut drivers
Loctite #271

NOTE

Supplied with the system are:

one small wrench (stored under fluoro timer panel) for adjusting the fluoro timer

one large open end wrench to adjust the table and tubestand adjustable bearings (4144.474.03).

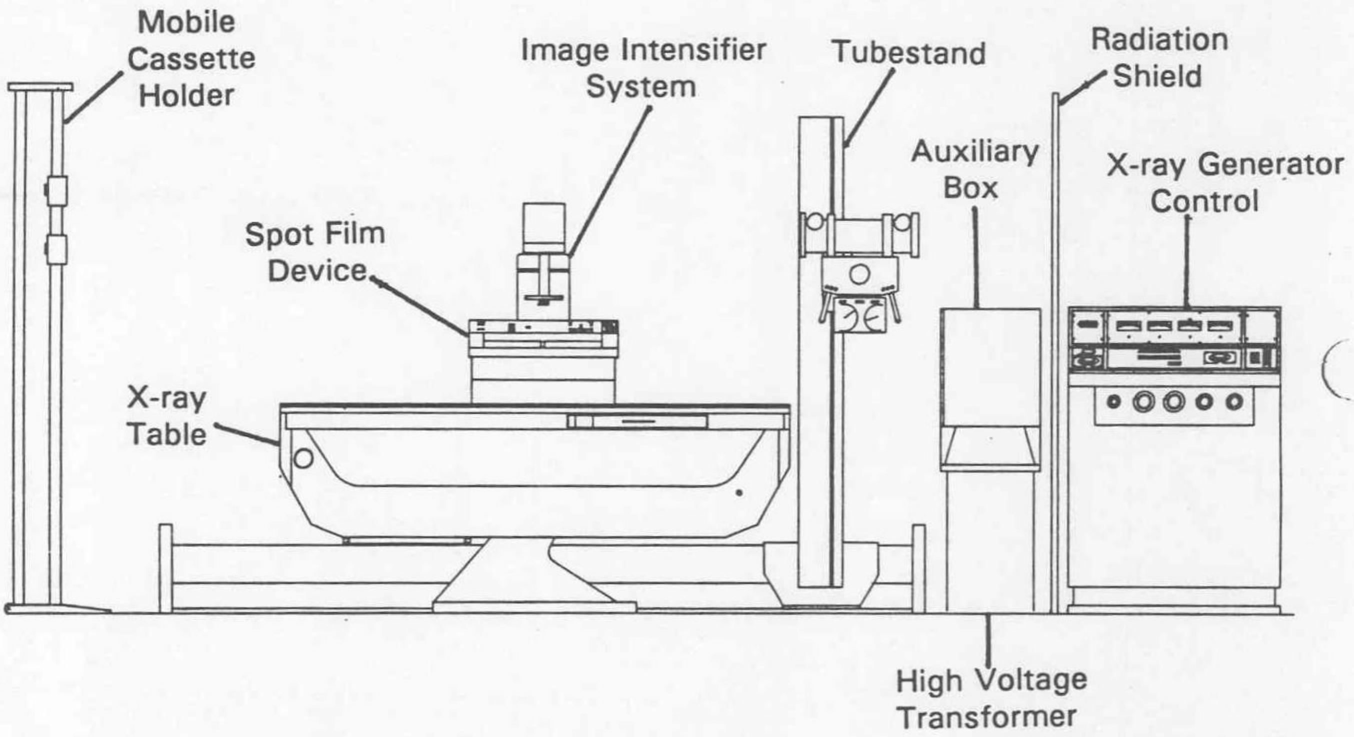

Mobile Cassette Holder
Image Intensifier System
Tubestand
Radiation Shield
Auxiliary Box
X-ray Generator Control
Spot Film Device
X-ray Table
High Voltage Transformer

FIGURE 1-1 EQUIPMENT LAYOUT, OPERATIONAL MODE

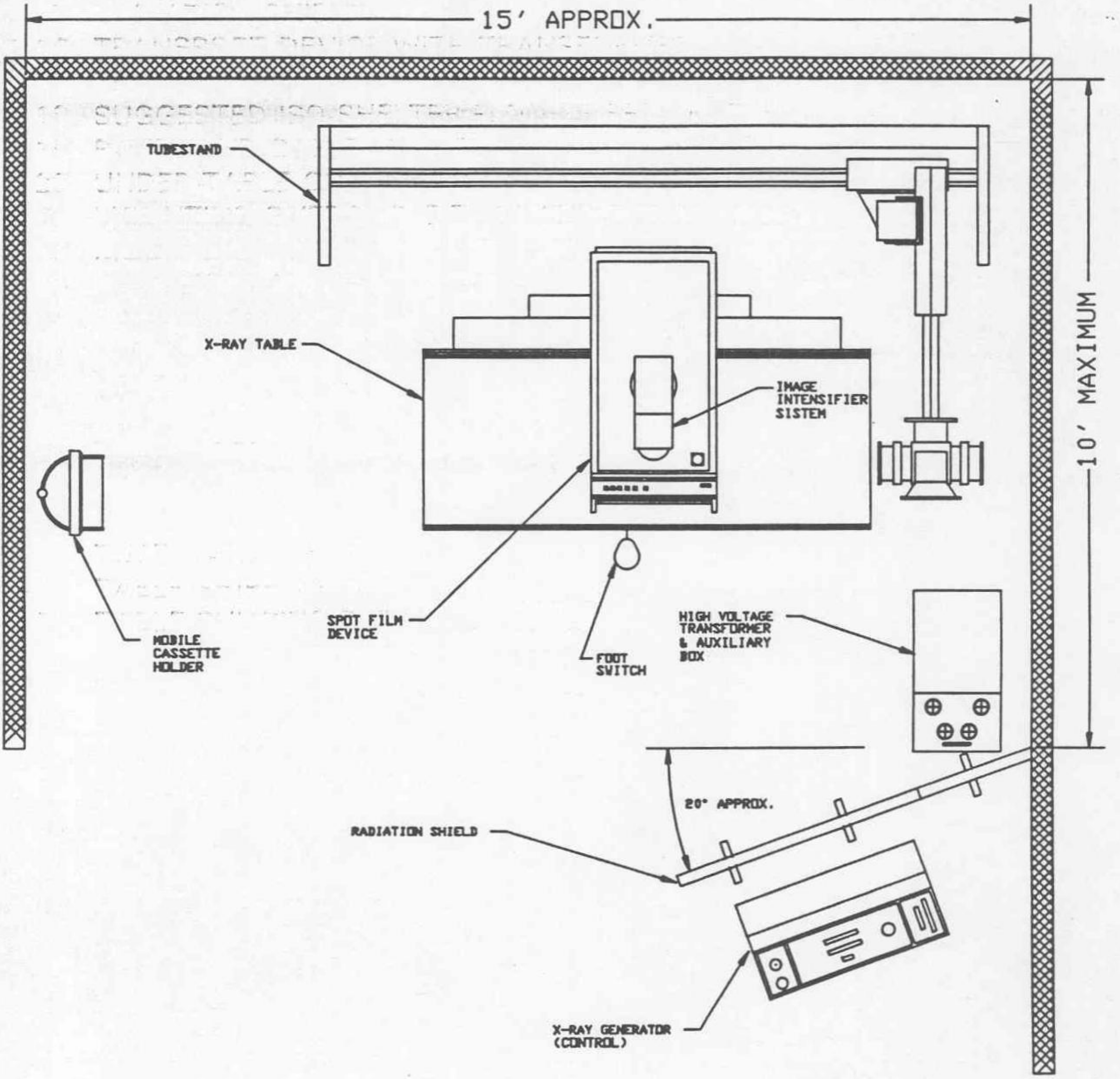

15' APPROX.
TUBESTAND
X-RAY TABLE
IMAGE INTENSIFIER SISTEM
10' MAXIMUM
MOBILE CASSETTE HOLDER
SPOT FILM DEVICE
FOOT SWITCH
HIGH VOLTAGE TRANSFORMER & AUXILIARY BOX
20° APPROX.
RADIATION SHIELD
X-RAY GENERATOR (CONTROL)

FIGURE 1-2 EQUIPMENT LAYOUT, SYSTEM FREE STANDING

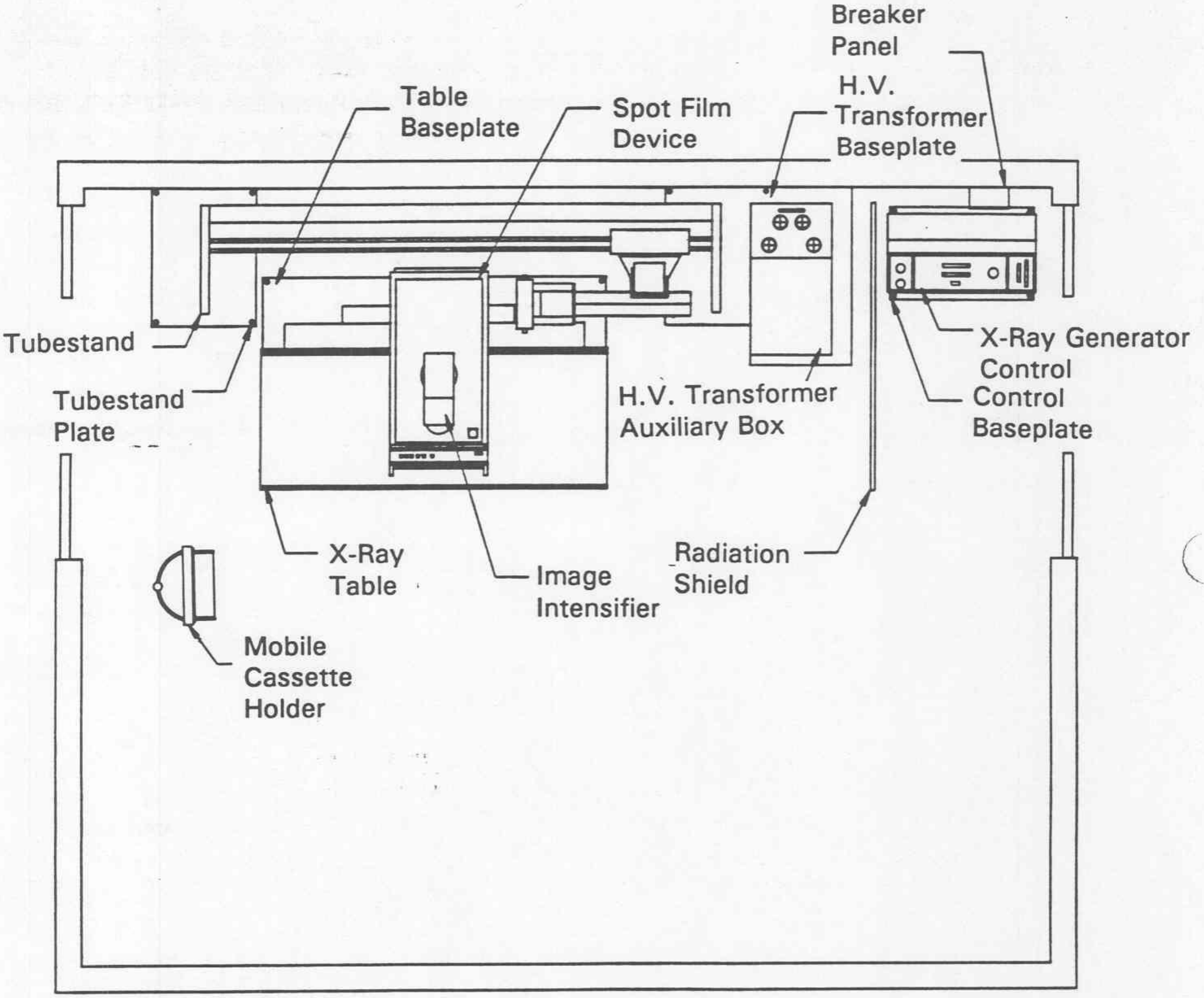

Breaker Panel
Table Baseplate
Spot Film Device
H.V. Transformer Baseplate
Tubestand
Tubestand Plate
H.V. Transformer Auxiliary Box
X-Ray Generator Control
Control Baseplate
X-Ray Table
Image Intensifier
Radiation Shield
Mobile Cassette Holder

FIGURE 1-3 INSTALLATION IN AN EXPANDABLE ISO SHELTER

1.3 EQUIPMENT REQUIRED

Transport device (refer to **Section 1.7**)

Ramp to support weight of at least 2000 pounds for moving heavy components from ground level to interior of ISO-shelter

1.4 CONTENTS OF SHIPPING CRATES

CRATE NUMBER	DESCRIPTION OF CONTENTS
1	tools, manuals, interconnecting cables, table accessories
2	tubestand
3	x-ray table, spot film device
4	radiation shield
5	x-ray control, cassette stand
6	transformer, auxiliary cabinet
7	x-ray tubes, collimators, image intensifier

1.5 UNPACKING

WARNING:

DANGER OF PERSONAL INJURY PRESENT!

The radiation shield should be stored and unpacked in a flat position to prevent toppling.

The CS-8952 X-Ray System is shipped in several shipping crates, some of which contain several components. Before unpacking each crate, move it as close as possible to the installation site.

Exercise caution during unpacking and installation to prevent damage to the contents of each crate and loss of small parts.

____________2 sets of manuals

____________interconnecting cables

____________patient hand grips

____________urological knee crutches

____________compression band device

____________shoulder rest

____________foot rest

____________head clamp

____________tubestand

____________over-table collimator

____________over-table x-ray tube

____________over-table HV cables

____________ . . . .

____________x-ray table

____________spot film device

____________image intensifier

____________table collimator

____________table x-ray tube

____________table HV cables

____________radiation shield

____________cassette stand

____________x-ray control

____________transformer

____________auxiliary box

____________transport device
(if applicable)

____________. . . . .

TABLE 1-1 CHECKLIST FOR UNPACKING

1.5 UNPACKING (continued)

NOTE:

The minimum door width for system installation is 48 inches without baseplates, or 54 inches with baseplates attached.

Remove padding and shipping blocks from the top and sides of the equipment as it is unpacked, as required. Lift the equipment from the base of the packing crate, using the transport device, if available, as necessary.

Visually inspect the contents of each crate as it is unpacked. The equipment is fragile and can be damaged by rough handling. Inspect for dents, scratches, or other damage that may have occurred during shipping. Notify Continental X-Ray Corporation of any shipping damage.

NOTE:

Examine the bags containing the mounting hardware. If any of these bags are torn or otherwise damaged, contact Continental X-ray Corporation for the replacement of hardware not locally available.

1.6 DIRECTIONAL ASSIGNMENT NAMING CONVENTION USED

In the plan view of a CS-8952 System installation in an ISO-shelter **(FIGURE 1-3)**, the shelter walls are labeled North, South, East, and West. The instructions in this chapter will refer to the shelter walls following this convention, without regard to the shelter's actual geographic orientation.

The wall having the cargo doors will be referred to as the East wall; the wall nearest the cargo doors as the North wall; etc.

FIGURE 1-3 follows this convention by showing that the system is installed on or near the North wall of the shelter.

1.7 TRANSPORT DEVICE

If available, use the transport device (**FIGURE 1-4**) to move the MXR-350 Main Control, the High Voltage Transformer, the MXT-90/15 Table, and the CTC Tubestand.

There are two configurations for the transport device: the integrated configuration to move the high voltage transformer and main control; and the separated configuration to move the tubestand and the table.

For the integrated configuration, the two cross bars that are attached to the sides of each dolly are cross-linked to the lower pins on the opposing dolly, and then secured in place with the attached pendant safety pins (see **FIGURE 1-4**).

Insert a pin near the center of one cross bar into a hole on the opposing cross bar, and also secure with a pendant safety pin.

For the separated configuration, the dollies are positioned at either end of the unit to be moved without the cross bars (**FIGURE 1-10**).

Each dolly is equipped with a jack screw for lifting the load with two crane forks.

Four pairs of crane forks are included with the transport device. Two pairs of these forks are for moving the MXT-90/15 Table and are equipped with pins (**FIGURE 1-5**).

The table crane forks are numbered 1 and 2 on the crane fork brace. One each number 1 and 2 table crane fork are used on both ends of the transport device dolly.

The remaining crane forks are smaller and are for use with the generator main control, high voltage transformer and the tubestand. **FIGURE 1-5** shows the holes in the small crane forks.

For a parts list of the transport device, refer to **Section 2** of this chapter.

1.8 MOVING THE TUBESTAND

The transport device uses the small crane forks to move the tubestand. The tubestand is fitted with slots in its base to accommodate the crane forks (**FIGURE 1-6**). To move the tubestand, the transport device is used in its **separated configuration,** that is, without the cross bars forming an x-frame.

Open the crate containing the tubestand. The tubestand is shipped with the column lying flat and secured to the head-end panel by two bolts located under the end cover at the top of the column.

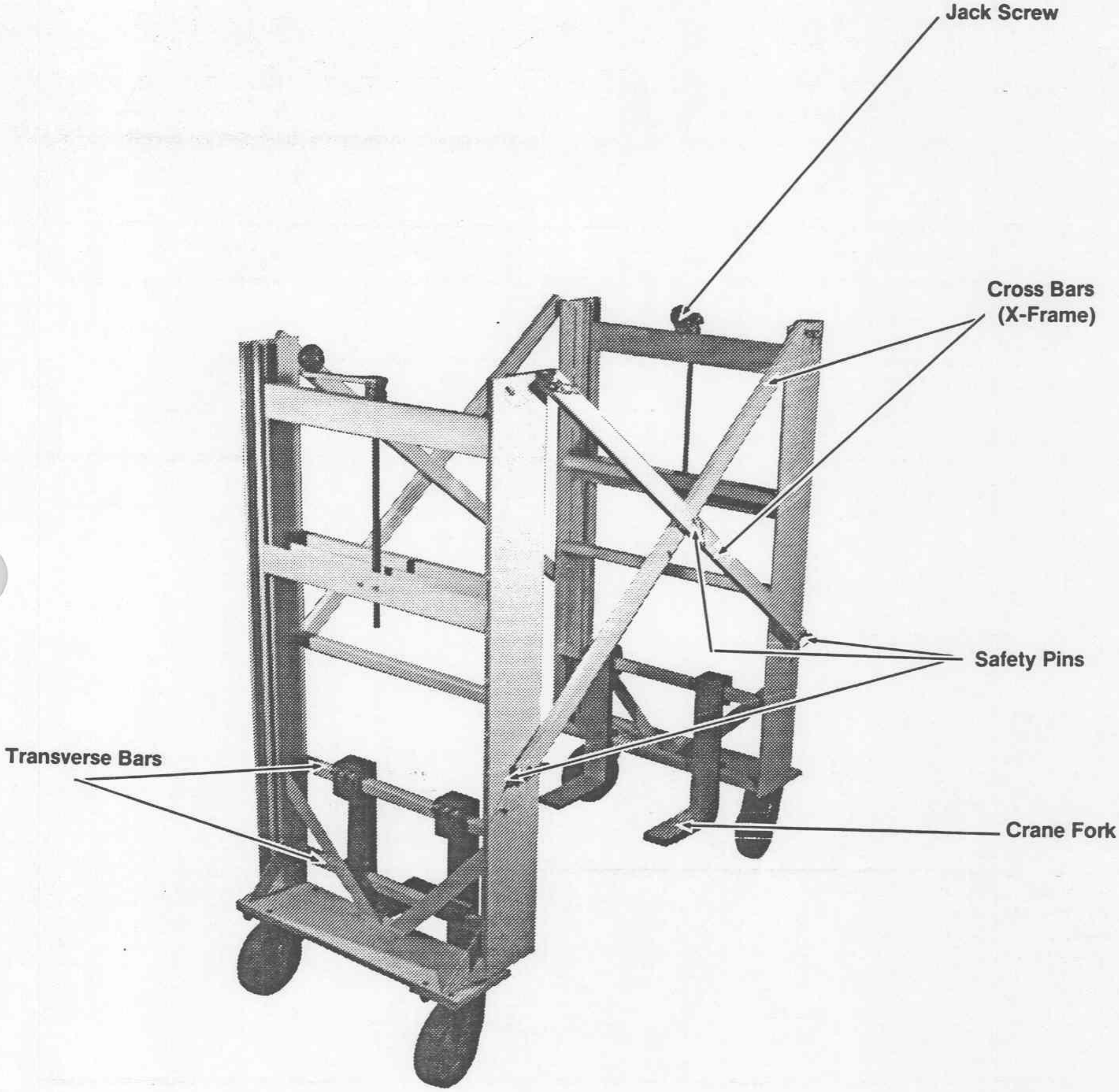

Jack Screw
Cross Bars (X-Frame)
Safety Pins
Transverse Bars
Crane Fork

FIGURE 1-4 INTEGRATED CONFIGURATION: TRANSPORT DEVICE

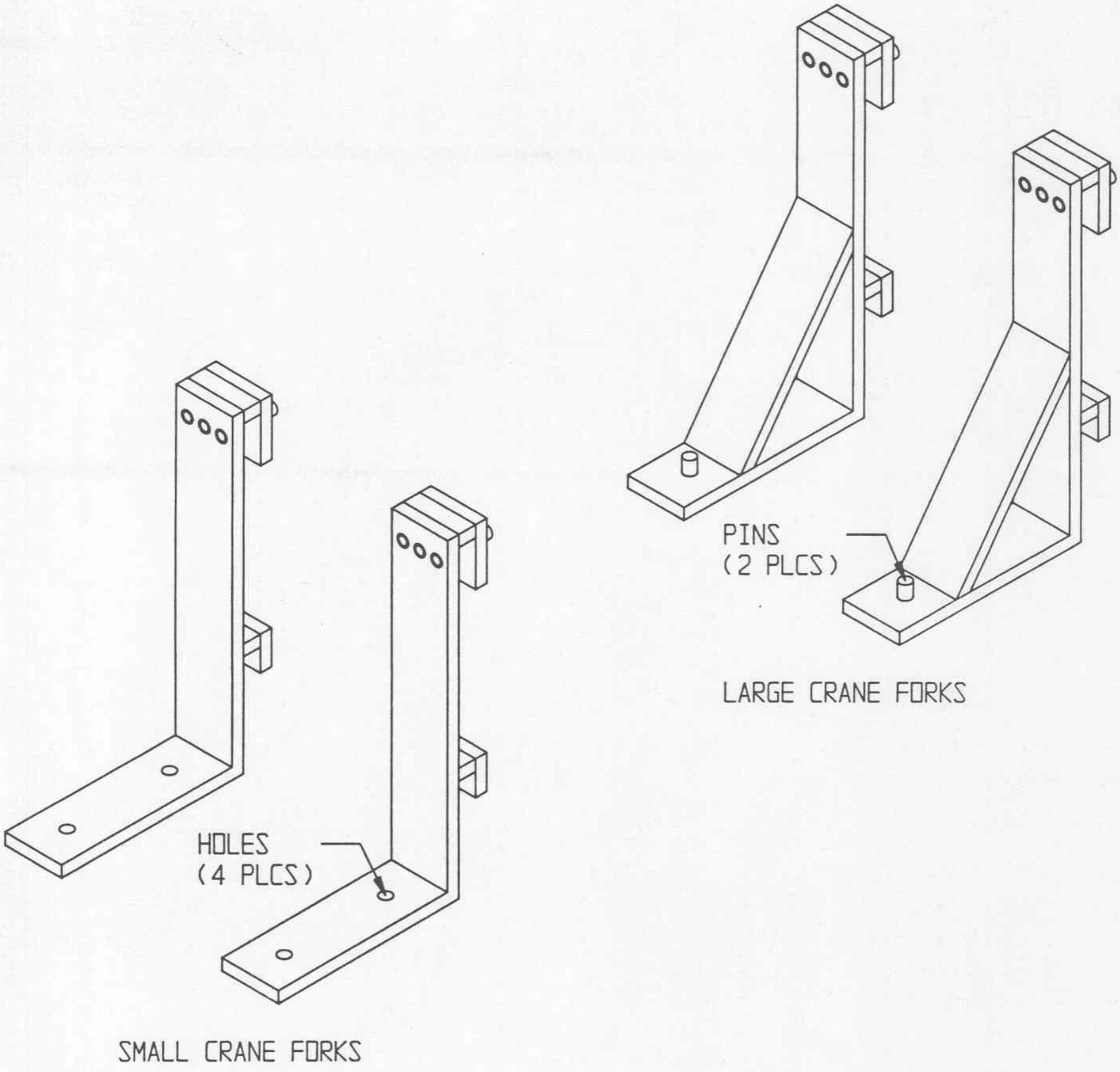

PINS
(2 PLCS)
LARGE CRANE FORKS
HOLES
(4 PLCS)
SMALL CRANE FORKS

FIGURE 1-5 TRANSPORT DEVICE CRANE FORKS

1.8 MOVING THE TUBESTAND (continued)

Adapt the transport device for use with the tubestand by positioning the crane forks without locating pins on both dollies on the lower transverse bars. Place one of the dollies at either end of the tubestand.

Align the crane forks with the slots in the tubestand base and push the crane forks into the slots far enough to enable the insertion of the retaining pins.

The tubestand is equipped with four retaining pins, one inside each corner of its end panel. These retaining pins are attached to the tubestand by means of safety cables. Insert one of these pins into the hole nearest the end of each crane fork (**FIGURE 1-6**).

Attach the dolly's cross bar at the rear side of the tubestand to the main frame of the tubestand using the 3/8-16 X 1-1/4" hex head cap screw that is about 18 inches from the end of the 6" square tube of the main frame. Repeat procedure for the remaining dolly.

Use the jack screws to slowly raise the crane forks until the tubestand clears the skid by at least 1 inch. Move the tubestand to its desired location.

1.8.1 MOUNTING THE TUBESTAND

If the tubestand is to be installed in an ISO-shelter, secure the tubestand baseplates to the floor. Baseplates are stamped for placement orientation. The baseplates for the tubestand are attached to the skid during shipping.

Lower the tubestand base into position on the baseplates. Remove the transport device by following the above procedure in reverse, **except do not reinstall the 3/8-16 hex head cap screws.**

There are two end-panels attached to the base of the tubestand. At the inside of one of the end-panels are two anchor brackets secured with two 1/4-20 screws, lockwashers and flat washers. Remove the tubestand anchor brackets from the end-panel.

At the opposite end-panel are two 1/4-20 screws, lockwashers and flat washers secured into mounting holes. Remove the hardware screwed into the mounting holes. Secure one bracket to the outside of each end-panel, using the hardware previously removed.

Attach the tubestand anchor brackets to the baseplates using four 3/8-16 X 1" bolts, flat washers and lock washers. The hardware is in a bag attached to anchor brackets.

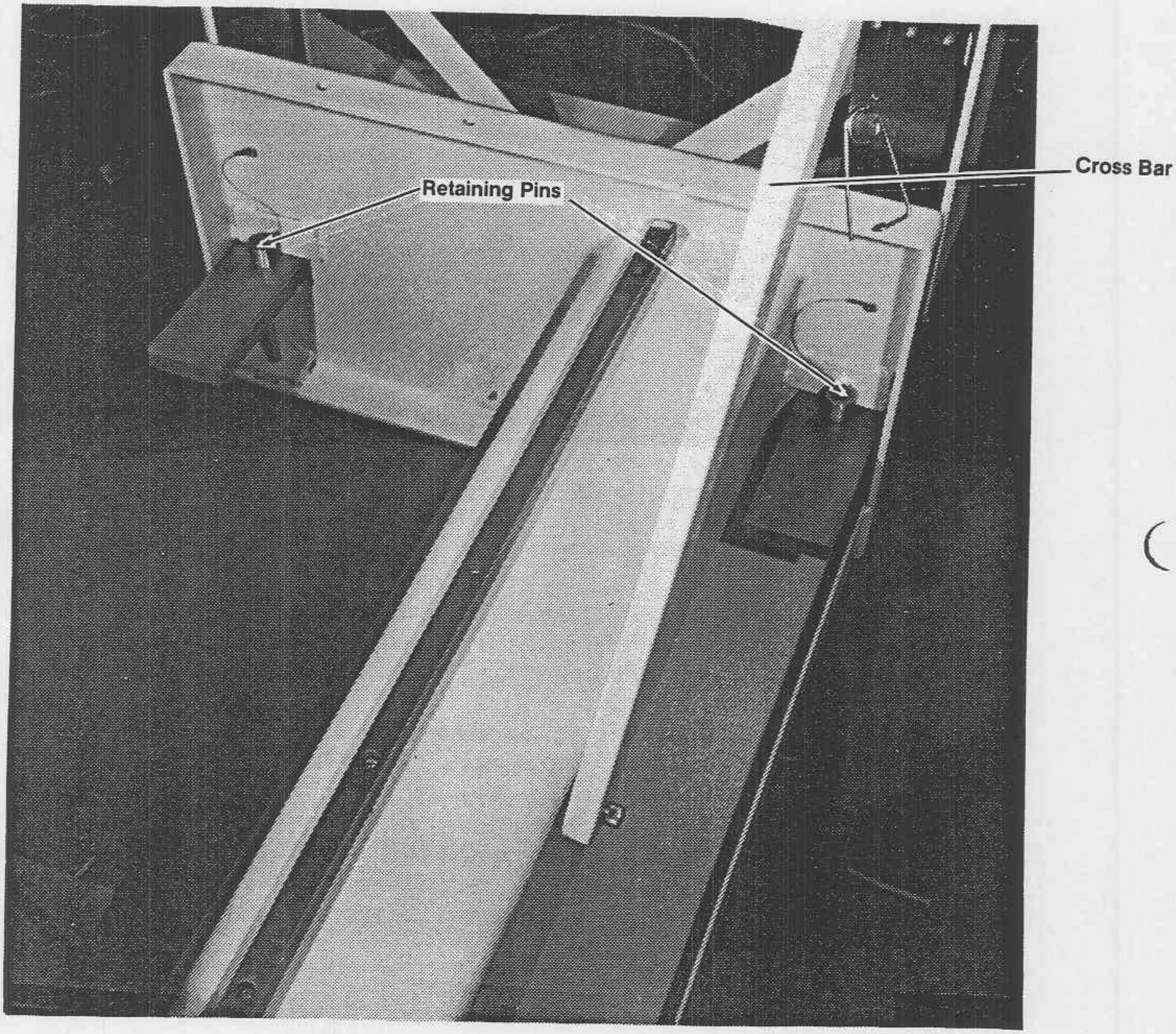

Cross Bar
Retaining Pins

FIGURE 1-6 TUBESTAND WITH CRANE FORKS IN THE SLOTS

1.8.1 MOUNTING THE TUBESTAND (continued)

Do NOT tighten the bolts at this time.

Remove the end cover from the top of the column and remove the two nuts that hold the column flat. Support the transverse arm so the column arm does not fall to the floor.

Inspect the counterweight and pulley assembly to ensure that the cable is on the pulley and no cable binding exists. Replace the end cover on the vertical column.

CAUTION:

The next step requires heavy lifting; use four people.

A fully assembled tubestand is supported by four bolts that hold the vertical column to the longitudinal carriage, one at each of three corners, and a fourth bolt at the bottom and offset from the corner. This bottom, offset bolt is the **pivot bolt.**

When shipped, the pivot bolt and a smaller bolt hold the vertical column in place. The other two bolts are secured to the longitudinal carriage. Leave the pivot bolt in place, but remove the other three bolts.

CAUTION:

To avoid equipment damage, do NOT remove the pivot (larger) bolt.

To assist in mounting the tubestand, use the shoulder bolt (on the longitudinal carriage) to hold the column in the upright position during the erection process.

Erect the column by lifting it into position. The column is now being supported by the pivot bolt and the shoulder bolt. To secure the column to the longitudinal carriage, insert and tighten the three 3/8-16 x 1-1/4" bolts with flat washers and lock washers on each, into the corresponding holes located on both the column base and the longitudinal carriage.

Once the column is secured, feed the high voltage, collimator, rotor and tubestand power cables through the rear opening in the panel at the foot end of the main frame. Pull all cables taut to assure unobstructed longitudinal travel of the tubestand.

Remove the two shipping brackets and secure them in place (**FIGURE 1-7** and **FIGURE 1-8**). **The vertical carriage will rise when the shipping brackets are removed.**

Reposition the transverse arm locking bolt (**FIGURE 1-9**).

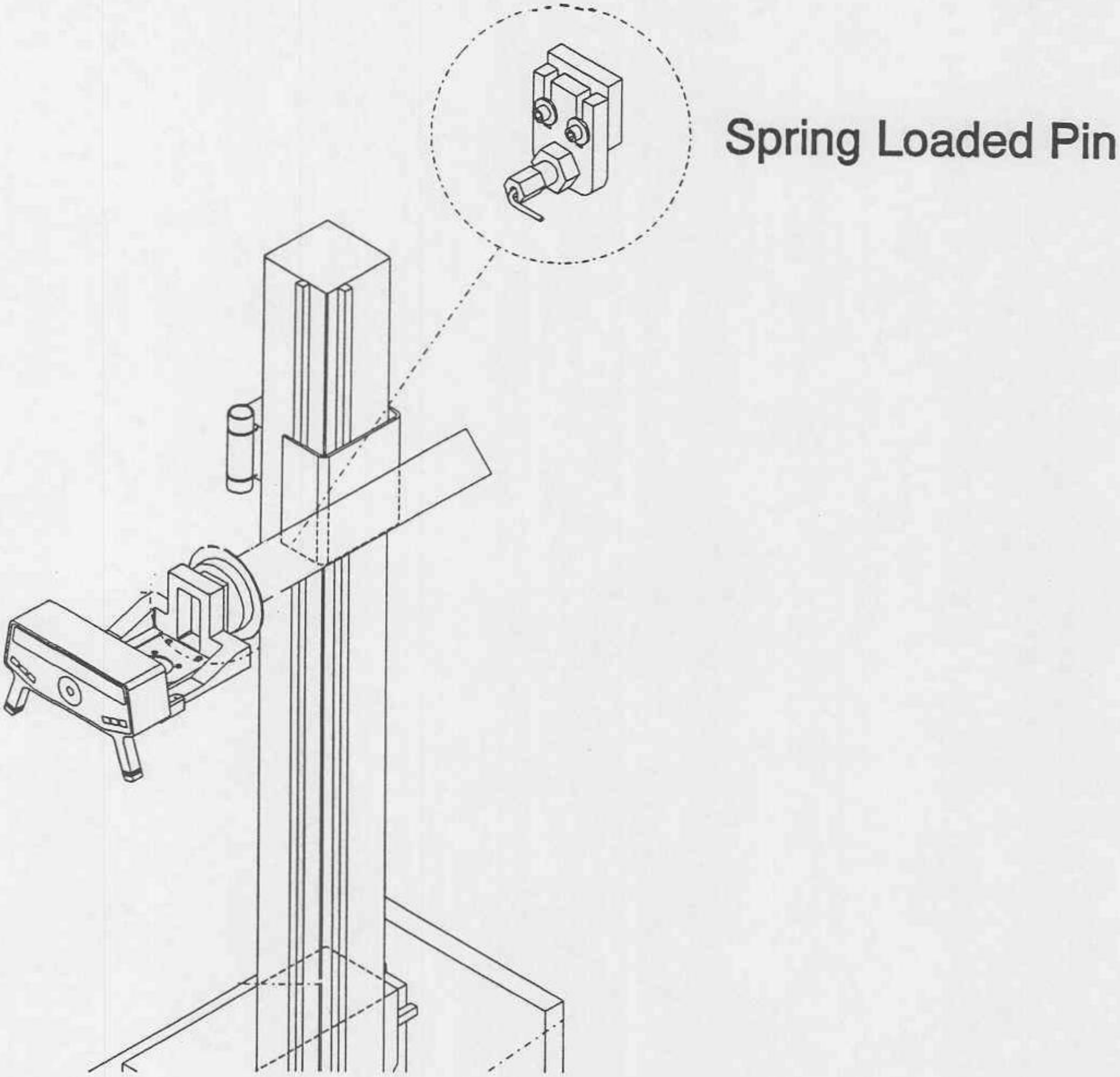


FIGURE 1-7 VERTICAL CARRIAGE SHIPPING BRACKET

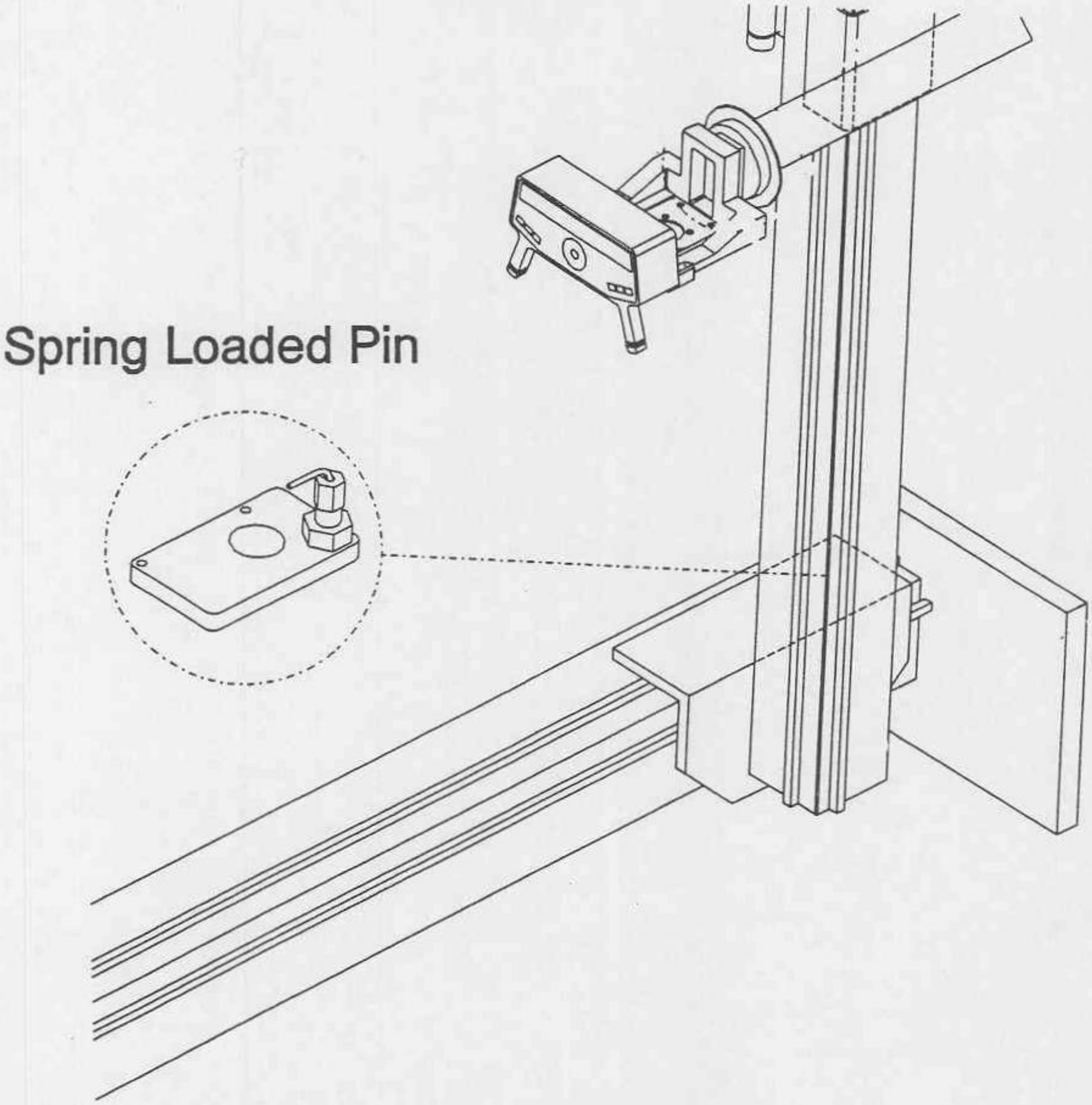


FIGURE 1-8 LONGITUDINAL CARRIAGE SHIPPING BRACKET

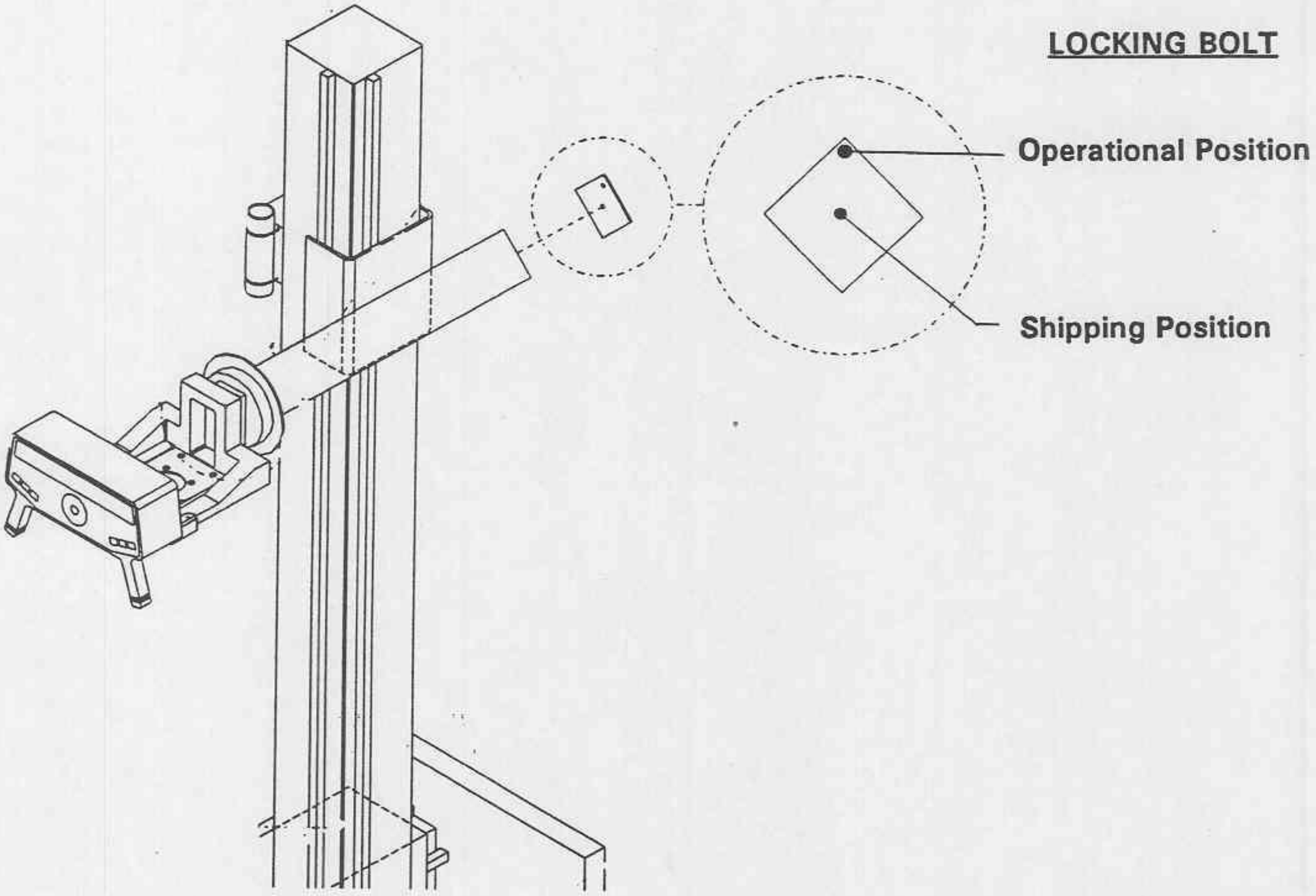

LOCKING BOLT
Operational Position
Shipping Position

FIGURE 1-9 TRANSVERSE ARM LOCKING BOLT

1.9 MOVING THE TABLE

CAUTION:

The table weighs approximately 1550 pounds fully assembled.
Use the transport device (or equivalent) while installing the table.

The transport device is used in its **separated configuration** for moving the table (**FIGURE 1-10**).

The transport device crane forks for the table are larger than those for the tubestand, and are fitted with locating pins.

Holes are drilled in the bottom of both ends of the table body to accommodate these pins. Adapt the transport device for use with the table by making sure that the crane forks with the locating pins are attached to both dollies on the middle two transverse bars.

Use a number 1 and 2 crane fork for each dolly. The numbers identifying the different crane forks are welded on the crane fork brace.

Unpack the MXT-90/15 Table, the spot film device, the under-table collimator and x-ray tube.

NOTE:

The table sub-top (barium shield) is NOT packing material and is required for operating the table. Do not discard with packing material.

A baseplate is attached to the table leg for weight distribution inside the shelter. This plate is bolted to the bottom of the shipping crate.

NOTE:

If installing the table in an ISO-shelter, or in a location with a weak floor, remove the bolts holding the baseplate to the skid, and leave the baseplate attached to the table.

If the table is to be installed in other locations, remove the bolts holding the table base to the baseplate.

Removal of the two large covers on the table base are required to find these bolts. Leave the baseplate attached to the skid.

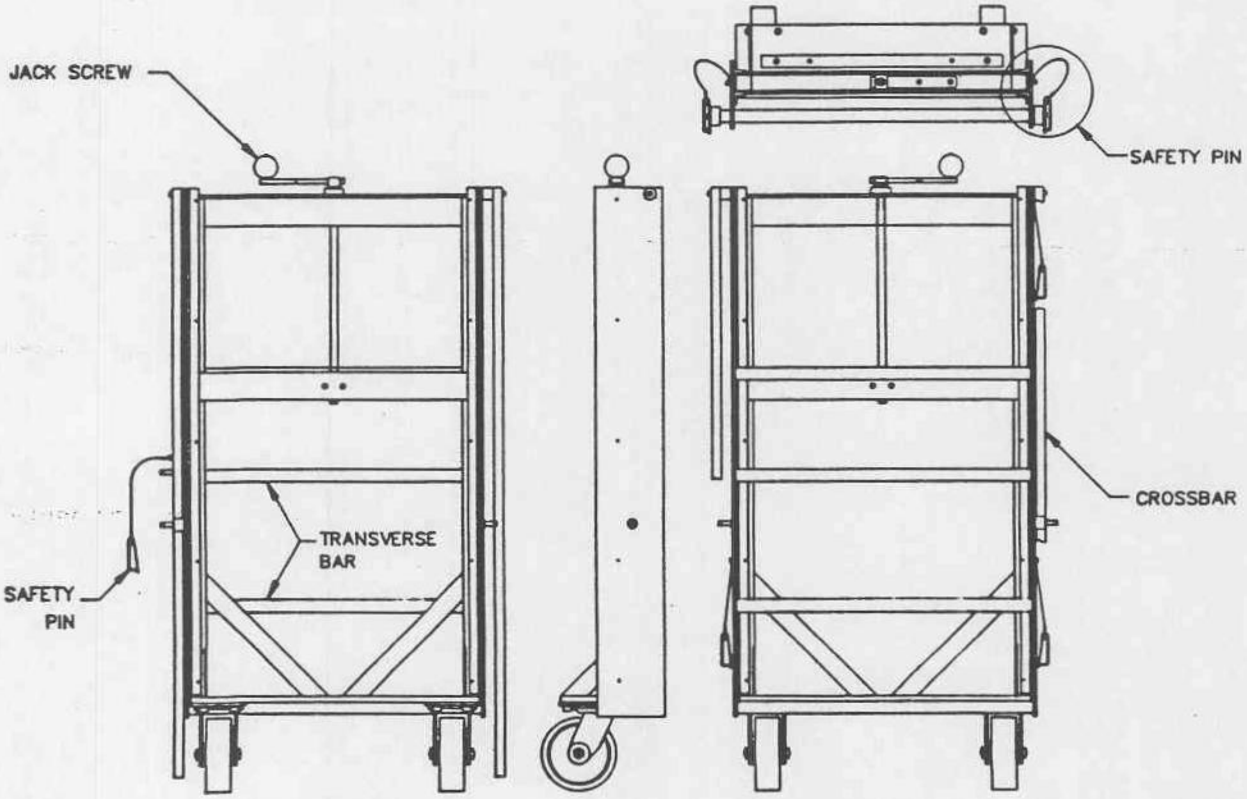

JACK SCREW
SAFETY PIN
TRANSVERSE BAR
SAFETY PIN
CROSSBAR

FIGURE 1-10 TRANSPORT DEVICE: SEPARATED CONFIGURATION

1.9 MOVING THE TABLE (continued)

NOTE:

The spring loaded check between the table radiation shield and the head-end of the table must be disconnected to prevent damage before moving the dollies into position.

See **FIGURE 1-11**.

Use the jack screw of either dolly to raise the crane forks to the height of the bottom of the table body.

Position the dolly at one end of the table and align the locating pins with the holes in the table body (**FIGURE 1-12**). These holes are on the flat portion of the table body adjacent to the sloping end panels.

The pin on **Fork 1** is longer and should be inserted into the table hole first. Raise slightly to keep **Fork 1** in place while **Fork 2** is repositioned to engage the other hole in the table body.

Use the jack screw to slowly raise the crane forks until the locating pins engage the holes in the table body.

NOTE:

The vertical portion of the crane fork is padded to protect the table body from damage as the crane forks are raised.

Repeat the above steps at the other end of the table with the remaining transport device dolly.

Raise the table body with the jack screws and crane forks until the body clears the skid by at least 1 inch (25 mm). Raise the table body evenly.

Use the transport device to move the table (and baseplate assembly) into position in front of the tubestand (**FIGURE 1-3**), with the tower to the rear.

Position the table with its back toward the North wall of the shelter.

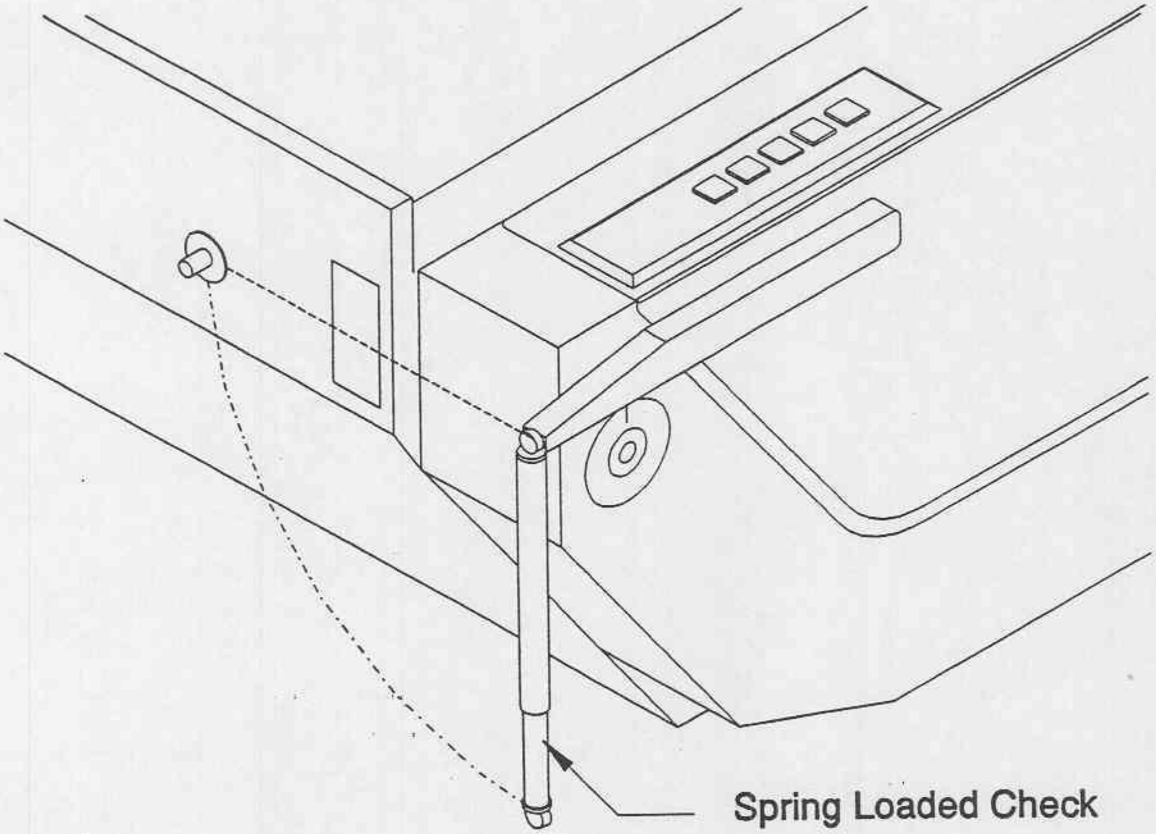

Spring Loaded Check

FIGURE 1-11 TABLE SPRING LOADED CHECK

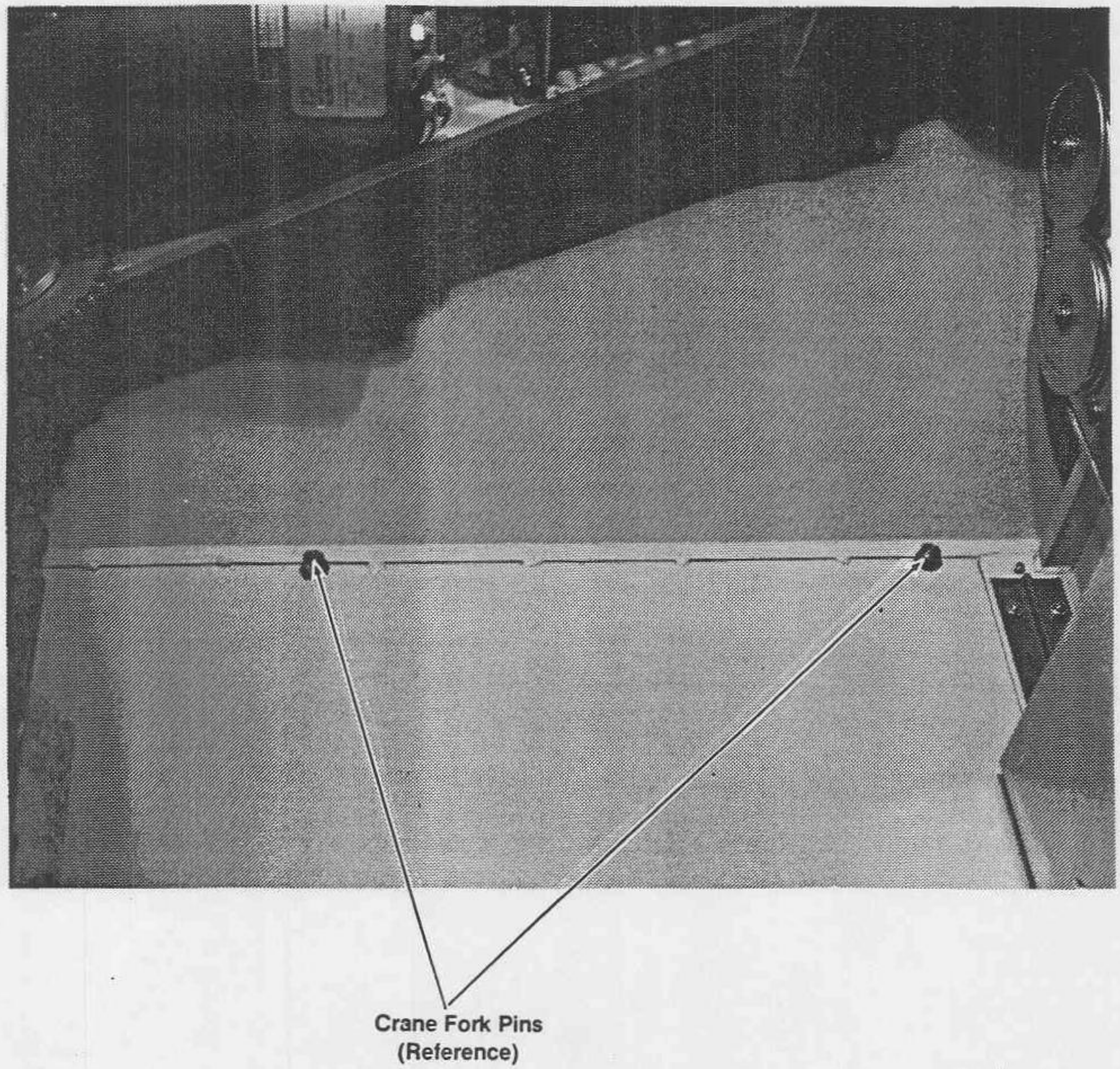

Crane Fork Pins
(Reference)

FIGURE 1-12 INSIDE TABLE VIEW, HEAD END, WITH CRANE FORK PINS

1.9.1 TABLE MOUNTING

NOTE:

The position of the table in relation to the tubestand must remain the same for all systems.

The outside edge of the head-end, end-panel of the tubestand is 41-1/4" from the head-end edge of the table base.

The rear edge of the table base is 22" from the front edge of the tubestand main frame.

Final alignment of the table to the tubestand is performed with the collimator light.

Lower the table and attach the mounting plate to the floor, using eight 3/8-24 X 1-1/2" bolts, flat washers, and lock washers.

Remove the dollies from the table.

Raise the vertical carriage to its highest possible position and lock it in place with the myelographic stop.

Replace the spring loaded check on the table radiation shield, which was removed to use the transport device.

Remove the lateral carriage/fluoro shipping lock (see **FIGURE 1-13**).

1.9.2 TABLE WIRING CONNECTIONS

NOTE:

The following in-line connections are marked with a red tag.

The table is wired for operation in an ISO-shelter. For installation in any other room, tilting and table top constraints can be deleted.

At the head end of the table, in the area of the terminal strips, locate two in-line connectors. At the foot end of the table is one in-line connector.

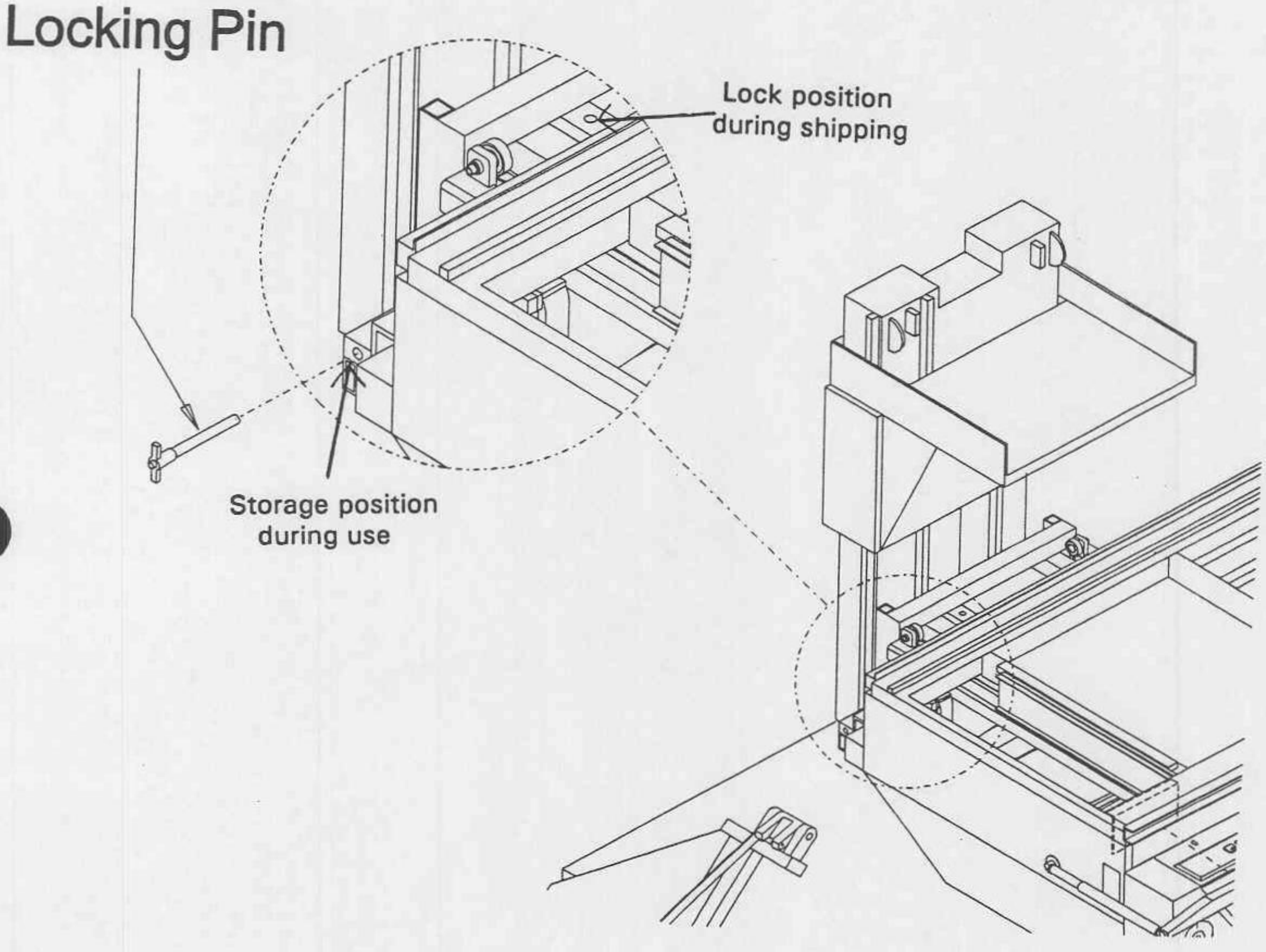

Locking Pin
Lock position during shipping
Storage position during use

FIGURE 1-13 TABLE LATERAL CARRIAGE/FLUORO SHIPPING LOCK

1.9.2 TABLE WIRING CONNECTIONS (continued)

For the ISO-shelter the connections should be:

head end - single red wire connected to three black wires
head end - single black wire connected to one red-two black wires
foot end - disconnect in-line connector.

For other systems the connections should be:

head end - single red wire connected to single black wire
head end - three black wires connected to one red-two black wires
foot end - connect in-line connector.

1.9.3 TABLE TOP REMOVAL

See **FIGURE 1-14.** To remove the table top, remove the three flat head phillips screws from the rear edge of the table top.

Push on the front edge of the top and lift it from the table.

Do not replace the table top until calibration, Chapter 3 of this manual, is completed.

Remove the three screws that attach the table top drive bracket to the frame.

Manually adjust the drive bracket until the frame moves freely.

Slide the frame to the foot end of the table. Remove the sub-top end bracket at the head end.

Using the "access holes" as needed, loosen the twelve screws that hold the four sub-top side brackets to allow the sub-top to slide under the brackets.

> **NOTE:**
>
> The sub-top (barium shield) is fragile! Handle with care!

Slide the frame to the head end of the table. Loosen the screws in the foot-end bracket.

Move the frame to the foot end. Gently slide the sub-top out at the head end.

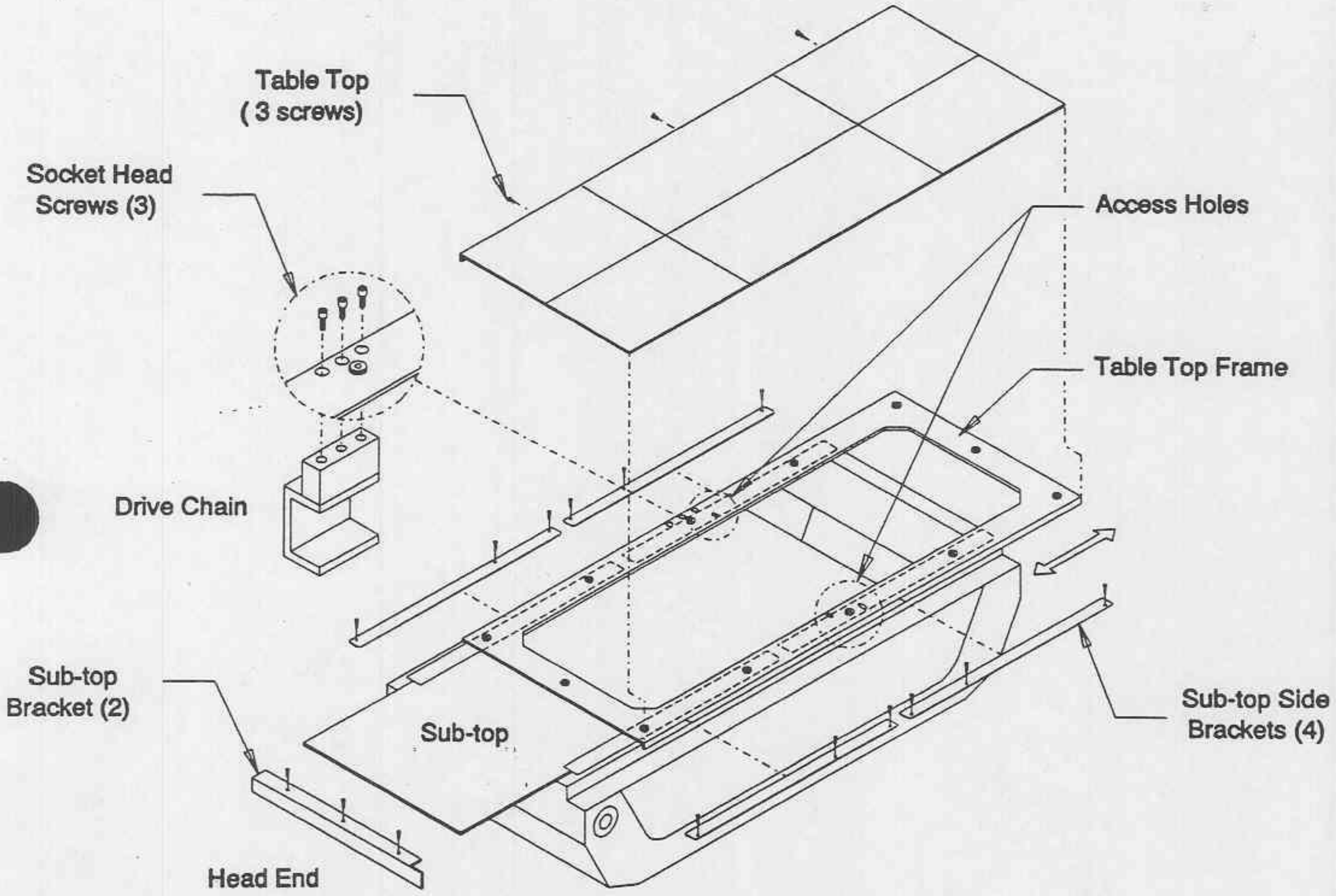


Table Top
(3 screws)
Socket Head
Screws (3)
Access Holes
Table Top Frame
Drive Chain
Sub-top
Bracket (2)
Sub-top
Sub-top Side
Brackets (4)
Head End

FIGURE 1-14 TABLE TOP REMOVAL

1.10 RADIATION SHIELD

WARNING:

DANGER OF PERSONAL INJURY!

The radiation shield should be stored and unpacked in a flat position to prevent toppling.

At least four persons are required for installation.

Unpack the radiation shield. The radiation shield is too tall to pass upright through the cargo doors; it is necessary to lay it flat in order to carry it into the ISO-shelter.

Erect the shield after it is inside the shelter. Use caution to avoid damaging the ceiling and overhead light fixtures.

Mount the wall brackets to the radiation shield and to the wall. See **FIGURE 1-15.**

For free standing use, attach the wheels (supplied) to the radiation shield. Remove the four loose brackets with wheels, held by tie wraps to the mounting brackets.

With four people, turn the radiation shield over so that the side with attached brackets is underneath.

Attach the four brackets to the wheels on the exposed side.

With four people, carefully move the radiation shield to an upright (vertical)) position.

WARNING:

DANGER OF PERSONAL INJURY!

The radiation shield may blow over if left in an unprotected (i.e., windy) area.

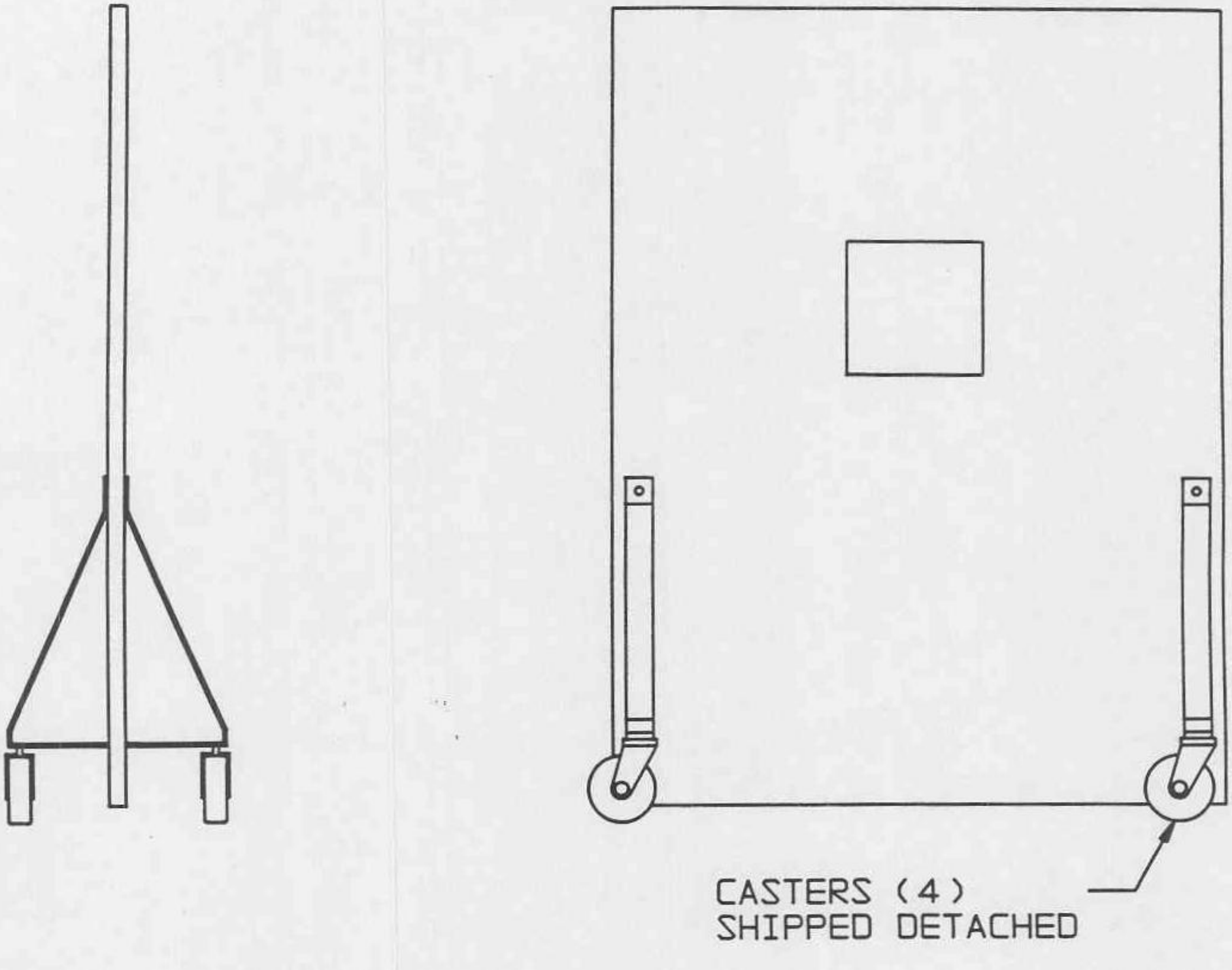

CASTERS (4)
SHIPPED DETACHED

FIGURE 1-15 RADIATION SHIELD

1.11 MOVING GENERATOR COMPONENTS

CAUTION:

The generator's main control weighs approximately 510 pounds (231 kg), and the high voltage transformer weighs approximately 650 pounds (295 kg).

Use the transport device (or equivalent) when handling.

Position the transport dollies approximately 36 inches (1 meter) apart with the transverse bars facing each other. Both transport device dollies are equipped with a pendant pin about two thirds down.

Connect one set of the cross bars between the dollies. Use three safety pins to hold the X-frame in place. Install the forks at the "closed end" of this assembly.

Each dolly is equipped with a jack screw for lifting with two small crane forks. The spacing between these forks is adjustable. The height of the crane forks can also be selected by attaching them to any one of the four transverse bars on each dolly.

The crane forks for the transformer (**FIGURE 1-16**) are on the upper-most transverse bars, and for the main control (**FIGURE 1-17**) are on the lower-most transverse bars.

When the generator components are unpacked and unscrewed from the skid (refer to 1.11.1), but still on the skid, position the partially assembled transport device around it.

If the generator unit is to be installed in an ISO-shelter, secure the baseplate to the floor.

Use the small crane fork on each dolly in the proper slot of the unit being moved.

Install the remaining X-frame on the side of the dollies and install the remaining forks on the proper pair of transverse bars.

Be sure to use the safety pins to hold the X-frame in place.

When moving the high voltage transformer, a tie bar (stowed on the bottom plate of the dolly) needs to be installed in the outer-most holes of the forks on both dollies to prevent the forks from separating.

Use the jack screws to raise the unit until it clears the skid by at least 1 inch (25 mm).

The generator unit can now be moved to the desired location. Remove the transport device by following the above procedures in reverse.

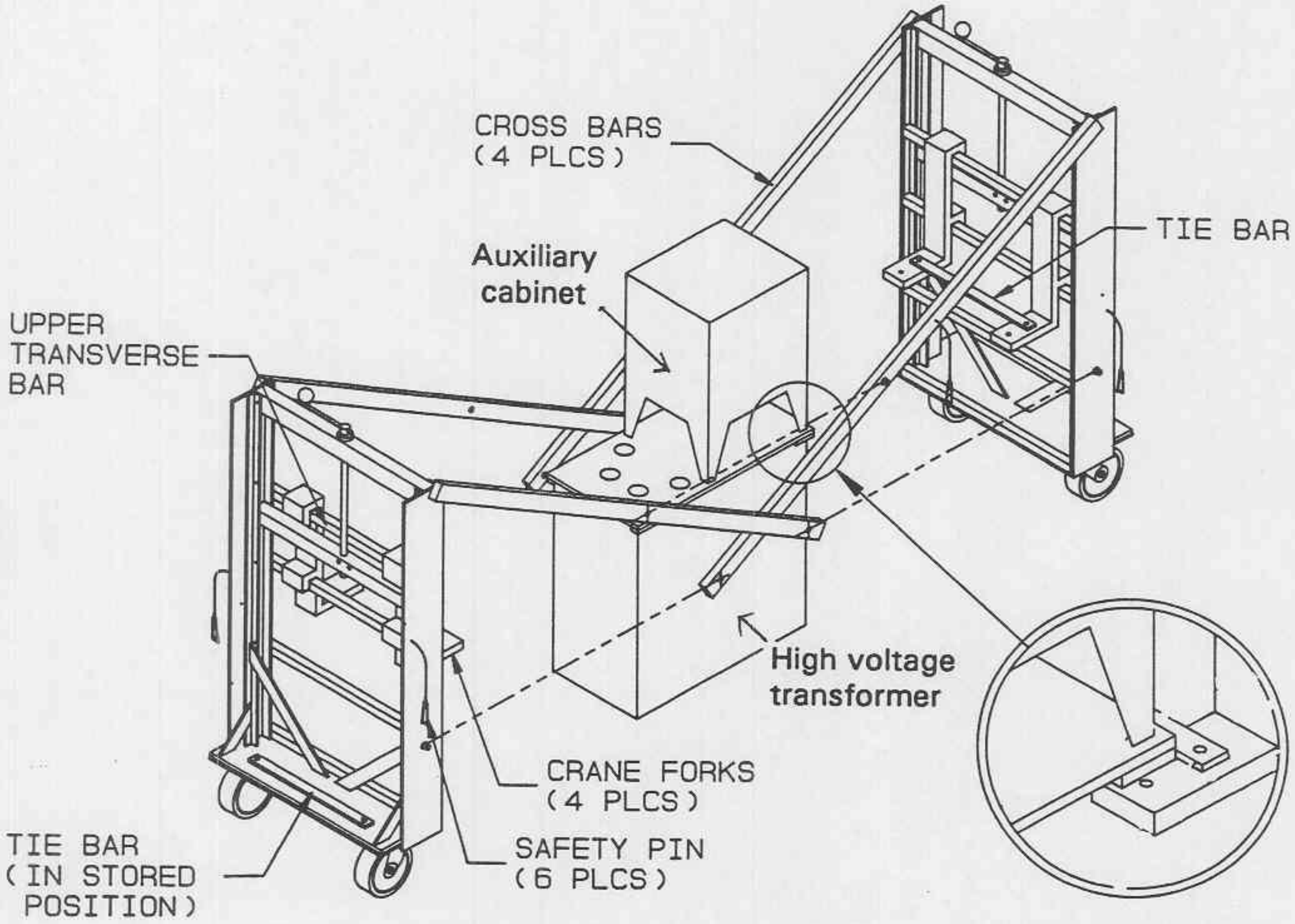

CROSS BARS
(4 PLCS)
TIE BAR
Auxiliary
cabinet
UPPER
TRANSVERSE
BAR
High voltage
transformer
CRANE FORKS
(4 PLCS)
SAFETY PIN
(6 PLCS)
TIE BAR
(IN STORED
POSITION)

FIGURE 1-16 TRANSPORT DEVICE WITH HIGH VOLTAGE TRANSFORMER/AUXILIARY BOX

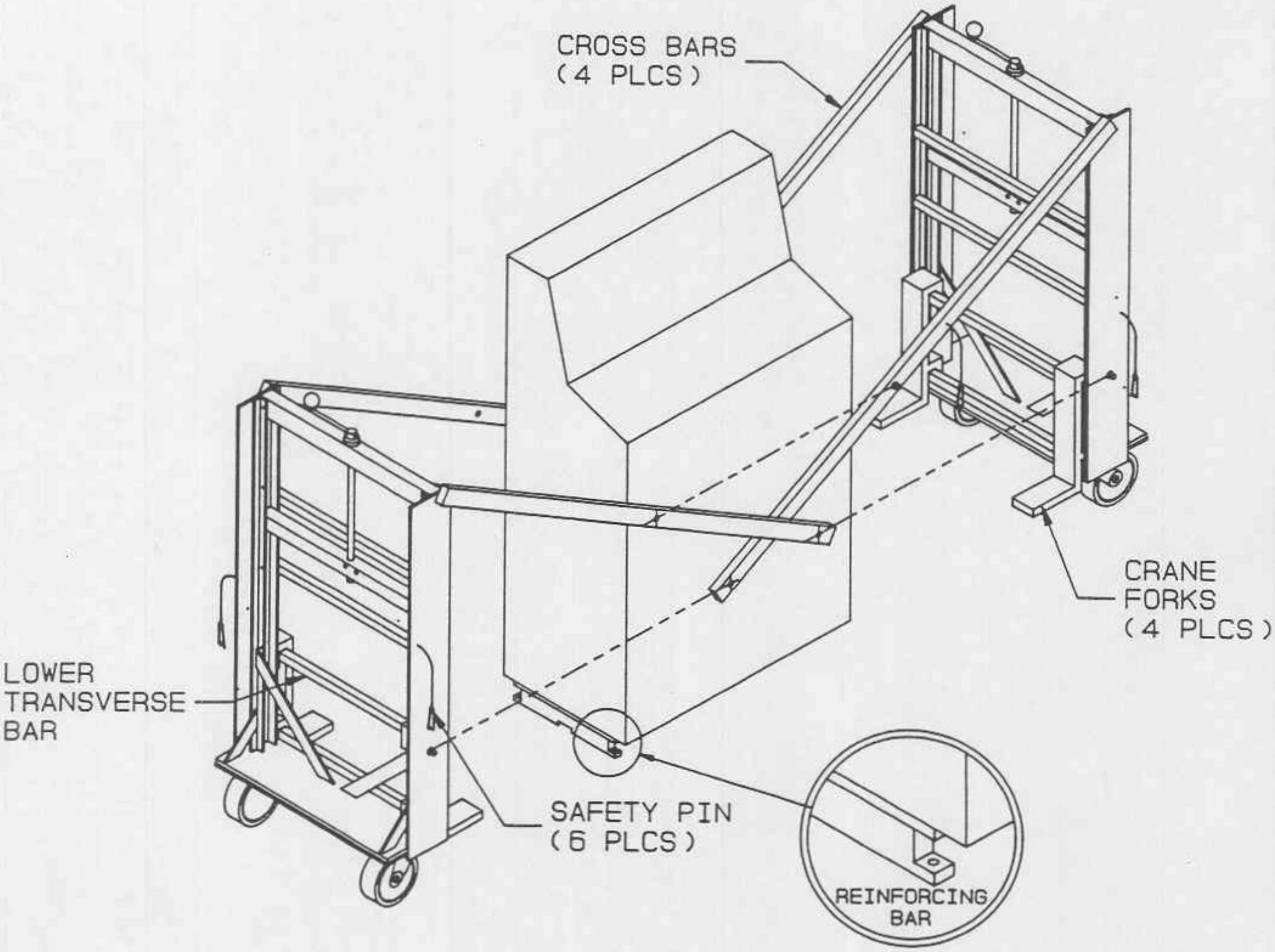

CROSS BARS
(4 PLCS)
CRANE
FORKS
(4 PLCS)
LOWER
TRANSVERSE
BAR
SAFETY PIN
(6 PLCS)
REINFORCING
BAR

FIGURE 1-17 TRANSPORT DEVICE WITH MAIN CONTROL

1.11.1 MOUNTING THE GENERATOR

The MXR-350 Generator consists of two units; the main control (**FIGURE 1-17**) and the high voltage transformer (**FIGURE 1-16**).

Do not unpack the main control until the high voltage transformer is installed.

Unpack the high voltage transformer at this time. The auxiliary cabinet is mounted on top of the high voltage transformer.

Remove the bolts that hold the high voltage transformer to the packing crate base.

If the high voltage transformer is to be installed in an ISO-shelter, install the baseplate which is shipped bolted to the skid.

Move the high voltage transformer into the position indicated in **FIGURE 1-18** inside the ISO-shelter, following the procedure in **Section 1.11**.

Lower the high voltage transformer onto the floor and secure in position using four 3/8"-16 X 1-" bolts, flat washers and lockwashers. Small positional adjustments may be needed to perform this step.

Remove the transport device from the high voltage transformer by following the procedure in **Section 1.11** in reverse.

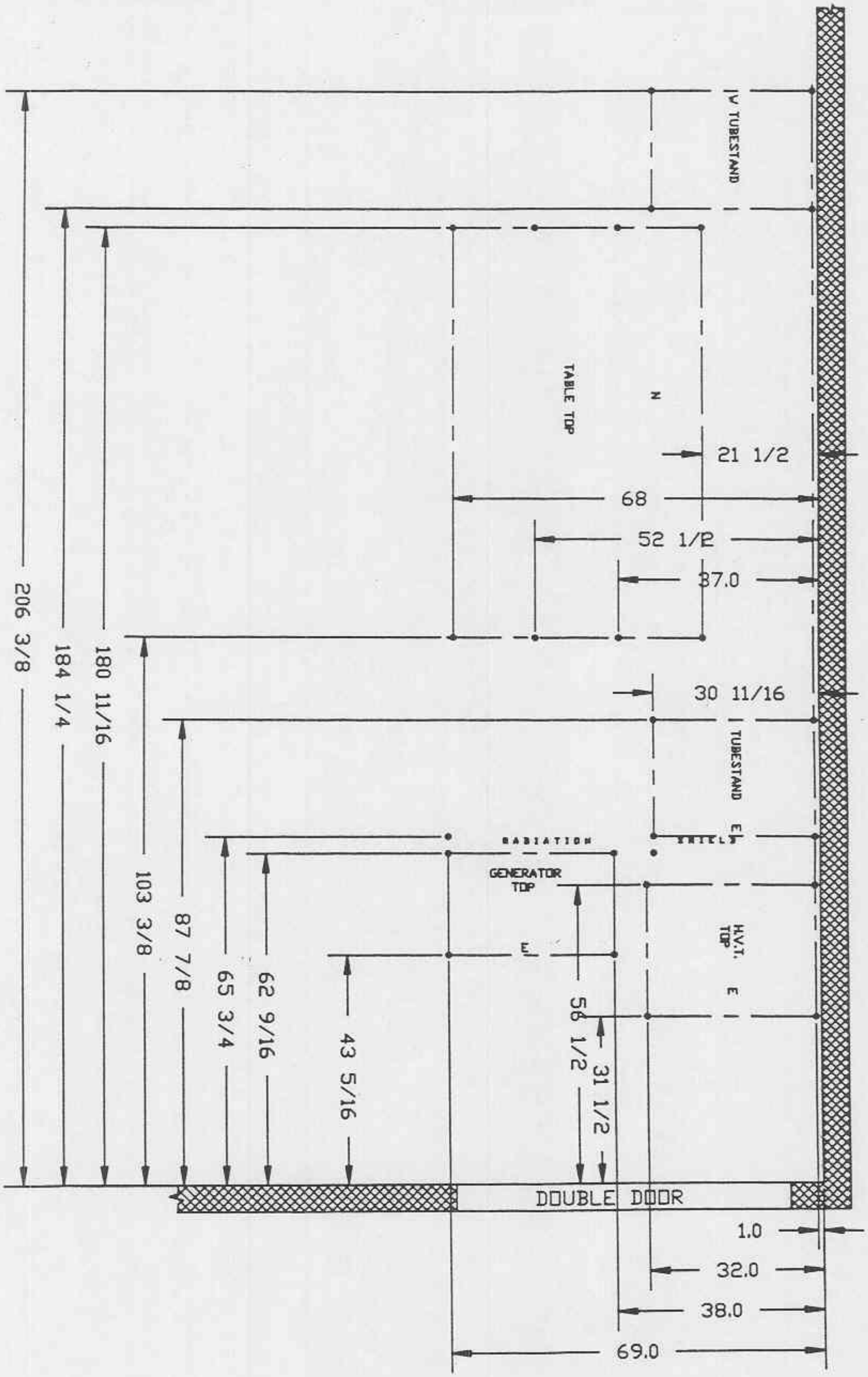
Unpack the main control at this time and detach it from the skid of the shipping crate.

If the main control is to be installed in an ISO-shelter, secure the baseplate to the floor.
The baseplate is secured to the tubestand skid.

Move the main control over its mounting holes in the shelter floor (**FIGURE 1-16**) following the procedure in **Section 1.11**.

Lower the main control onto the floor and secure into position using four 3/8"-16 X 1" bolts, flat washers and lockwashers. Small positional adjustments may be needed to perform this step.

Remove the transport device by following the procedure in **Section 1.11** in reverse.


TUBESTAND
TABLE TOP
N
21 1/2
68
52 1/2
37.0
206 3/8
184 1/4
180 11/16
30 11/16
TUBESTAND
RADIATION
SHIELD
GENERATOR TOP
H.V.T. TOP
E
103 3/8
87 7/8
65 3/4
62 9/16
43 5/16
56 1/2
31 1/2
DOUBLE DOOR
1.0
32.0
38.0
69.0

NOTE:
ALL HOLES ARE 3/8-24 EPOXY-POTTED INSERTS

FIGURE 1-18 SUGGESTED ISO SHELTER FLOOR INSERT PATTERN

1.11.1 MOUNTING THE GENERATOR (continued)

NOTE:

This unit is shipped from the manufacturer in the 60 Hz configuration. If operation is 50 Hz, see the calibration chapter of this manual, Chapter 3, **Section 2.2.**

Terminate the free end of the 12 foot main power cable into a 200 ampere circuit breaker at the power entry panel, in accordance with applicable National Electrical Manufacturer's Association (NEMA) standards.

Reference **FIGURE 1-19** for cable and panel mounting.

WARNING!

POTENTIAL HIGH VOLTAGE SHOCK!

DO NOT APPLY POWER TO THE SYSTEM AT THIS TIME.

Dress the main power cable across the shelter ceiling by using at least six (6) 8-inch tie wraps to secure it to the overhead conduit. Make sure that the cable does not interfere with access to the shelter through the West door.

Connect the free end of the power cable from the main control to a breaker panel.

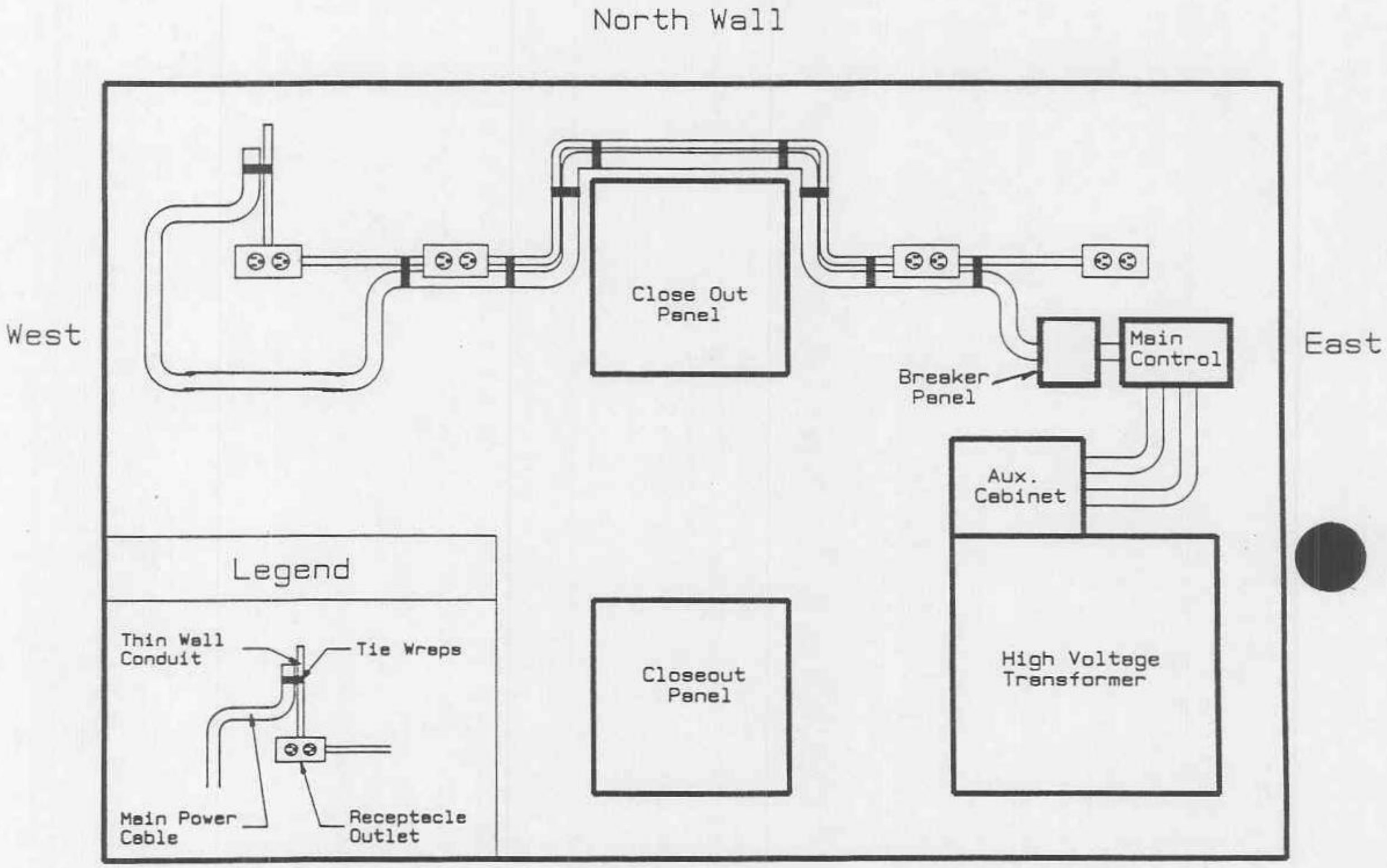
This power cable is the only one from the main control without a jack. The free end has 3 wires of number 2 gauge. The green wire is ground.

1.12 MOUNTING THE UNDER-TABLE COLLIMATOR AND X-RAY TUBE

See **FIGURE 1-20**. Unpack the under-table x-ray tube and position it beneath the bottom of the mounting frame. The system has two x-ray tubes, the under-table x-ray tube and the over-table x-ray tube.

The under-table tube has focal spots of .6 and 1.2, 12° target angle and 0° arm angle. The over-table tube has focal spots of 1.0 and 2.0, a 16° target angle and a 90° arm angle.

Refer to **FIGURE 1-20** for the under-table x-ray tube and **FIGURE 1-21** for the over-table x-ray tube. Note the difference between the positions of the mounting plates and the ports.


North Wall
West
East
Close Out Panel
Breaker Panel
Main Control
Aux. Cabinet
Legend
Thin Wall Conduit
Tie Wraps
Main Power Cable
Receptacle Outlet
Closeout Panel
High Voltage Transformer

(NOT TO SCALE)

FIGURE 1-19 PANEL AND CABLE MOUNTING

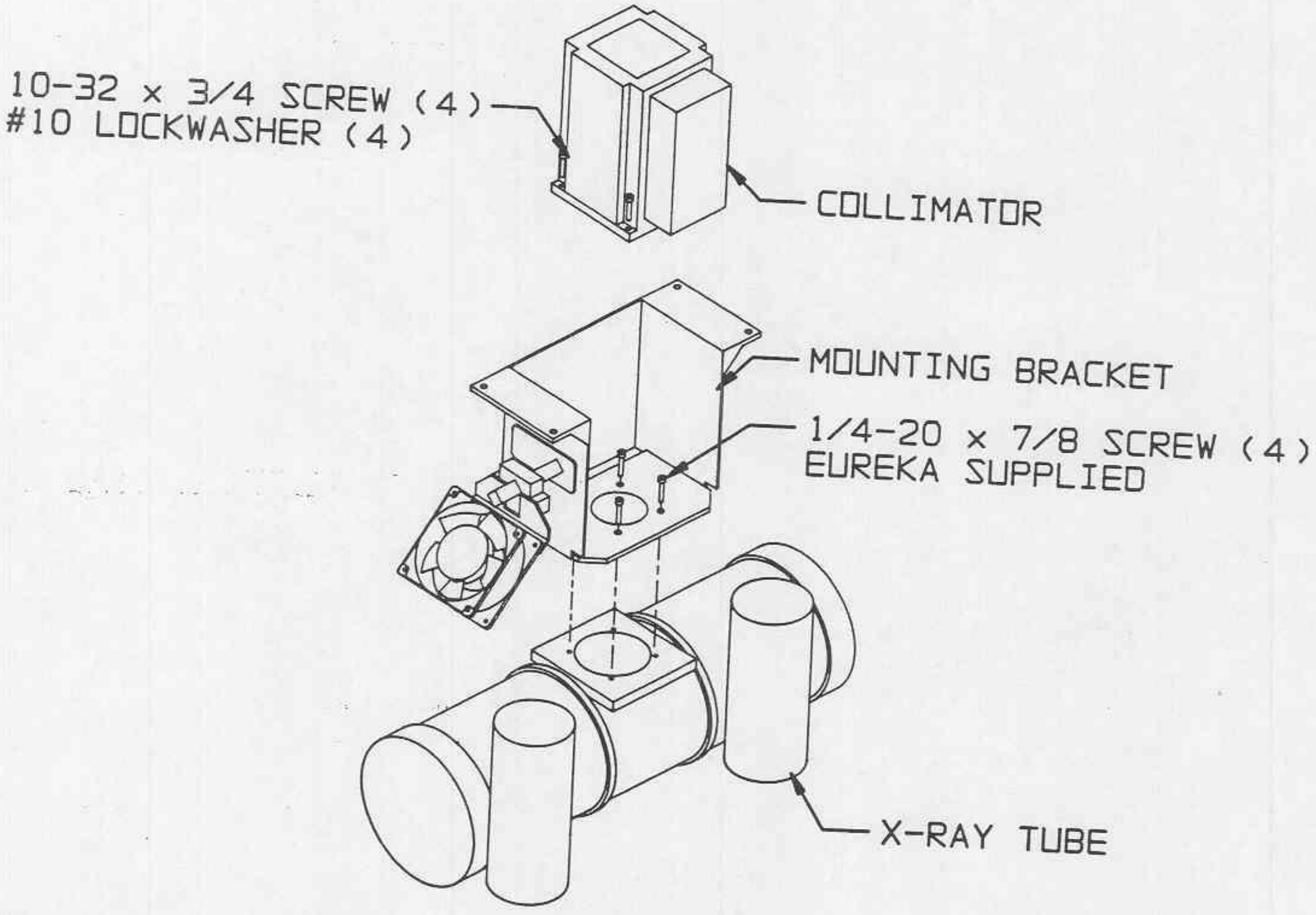

10-32 x 3/4 SCREW (4)
#10 LOCKWASHER (4)
COLLIMATOR
MOUNTING BRACKET
1/4-20 x 7/8 SCREW (4)
EUREKA SUPPLIED
X-RAY TUBE

FIGURE 1-20 UNDER-TABLE COLLIMATOR AND X-RAY TUBE MOUNTING

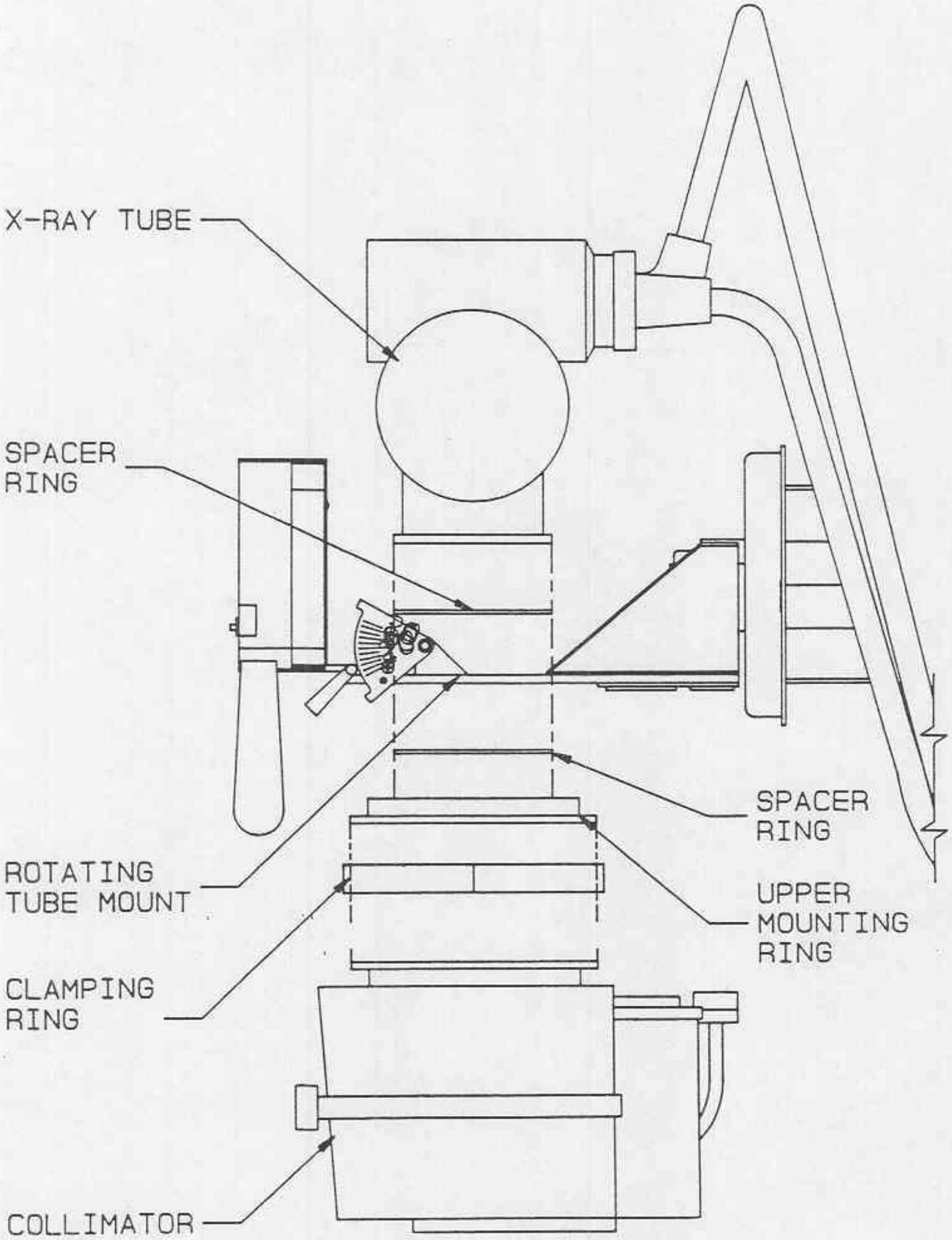

X-RAY TUBE
SPACER RING
SPACER RING
ROTATING TUBE MOUNT
UPPER MOUNTING RING
CLAMPING RING
COLLIMATOR

FIGURE 1-21 MOUNTING OVER-TABLE TUBE AND COLLIMATOR

1.12 MOUNTING THE UNDER-TABLE COLLIMATOR AND X-RAY TUBE (continued)

Secure the under-table x-ray tube to the mounting plate with four 1/4-20 x 3/4" phillips screws.

The anode of the tube must face toward the foot end of the table. (The anode side of x-ray tube has a small cable coming out of the end cap.)

CAUTION:

Be careful not to damage the collimator blades during installation.

Unpack the under-table collimator. Remove the cover that protects the collimator blades.

Secure the collimator to the mounting plate with the four phillips screws.

1.13 MOUNTING THE SPOT FILM DEVICE AND IMAGE INTENSIFIER

CAUTION:

The spot film device (SFD) weighs approximately 100 pounds (45.4 kg).

Two persons are needed to perform installation.

The power assist handle on the SFD is NOT capable of supporting the weight of the SFD. DO NOT use the handle to lift!

NEVER install, or remove, the SFD with the image intensifier system attached.

Do not place the SFD on a flat surface without protecting the cone (on the underside) or its carrier plate.

1.13 MOUNTING THE SPOT FILM DEVICE AND IMAGE INTENSIFIER (continued)

Remove the cover from the foot-end side of the vertical carriage on the tower.

Remove the two 1/4-20 screws that hold each of the two bearing blocks (**FIGURE 1-22**) containing linear ball bushings to the right side of the vertical carriage. Lift out the bearing blocks.

Remove the 10-32 screws from the left bearing rail that act as a rear bumper stop on the spot film device.

Two persons will be required to perform the following.

Carefully align the left SFD bearing rail into the tower left track bearings.

Center the SFD on the vertical carriage so that it has approximately equal overhang on the front and rear over the tower.

Replace the bumper stop screw at the rear of the left bearing rail, using the 10-32 screw that was removed.

Slide the bearing blocks that were removed above onto the 1/2" rod of the SFD.

Lift the right side of the SFD only enough to position the bearing blocks so they are aligned with their mounting holes.

Re-install the bearing blocks on the right side of the vertical carriage by replacing and tightening the four 1/4-20 screws removed.

Pull the SFD forward until it locks into its operating position.

Remove the small screw at the foot end of the apron track and install the lead apron by sliding its hangers onto the end of the rail on the right rear side of the SFD. Slide the apron all the way around to the front of the SFD. Re-install the small screw in the apron track.

Unpack the image intensifier system from its box. Position the imaging system on the SFD (**FIGURE 1-23**). Be sure that the image intensifier power supply is positioned toward the rear of the SFD.

Attach the image intensifier to the SFD, using four 1/4-20 X 1/2" screws. Connect the image intensifier power supply cable to the connector plug on the rear of the SFD front panel.

Replace all covers.

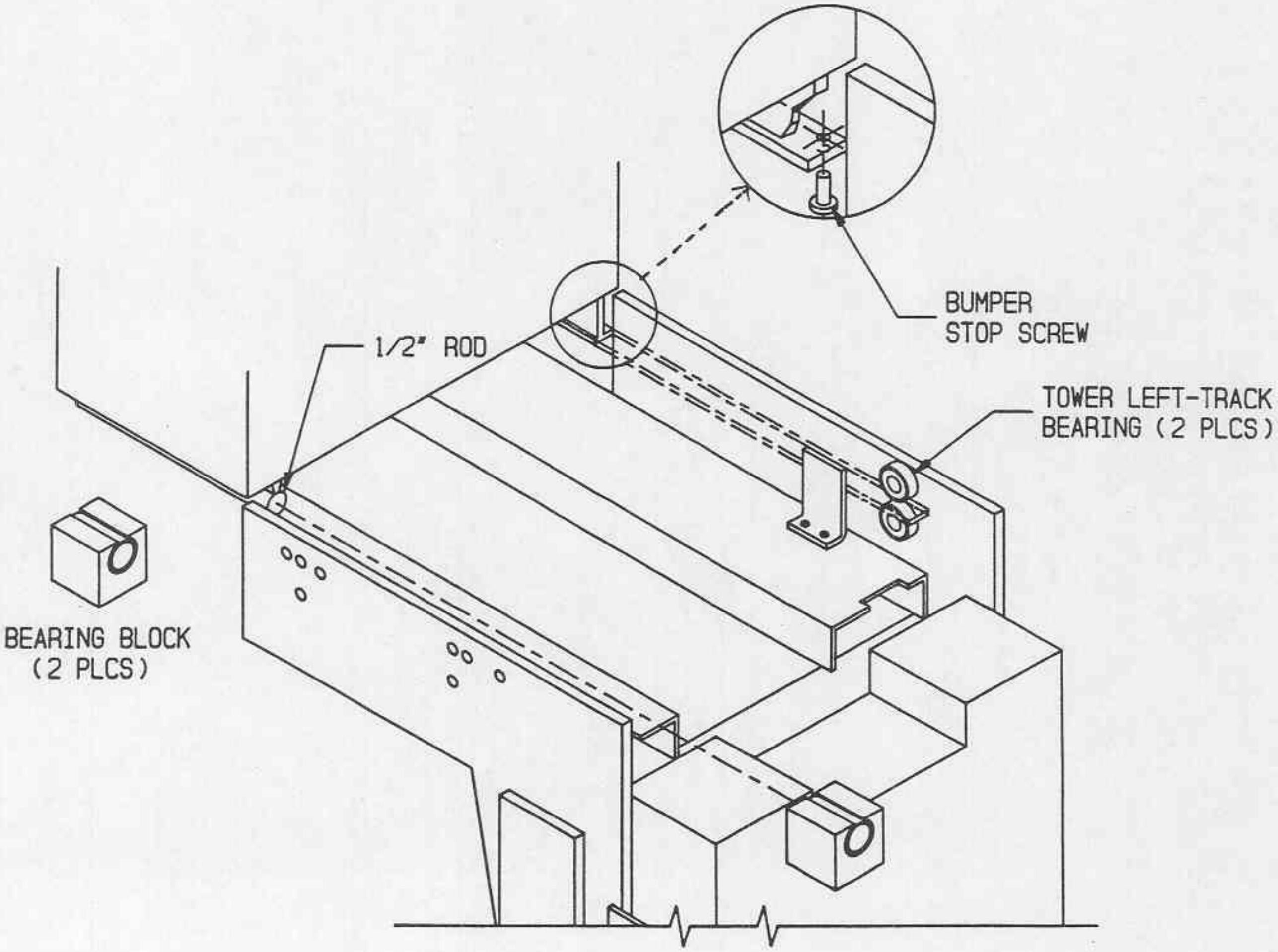

BUMPER
STOP SCREW
1/2" ROD
TOWER LEFT-TRACK
BEARING (2 PLCS)
BEARING BLOCK
(2 PLCS)

FIGURE 1-22 MOUNTING OF SPOT FILM DEVICE

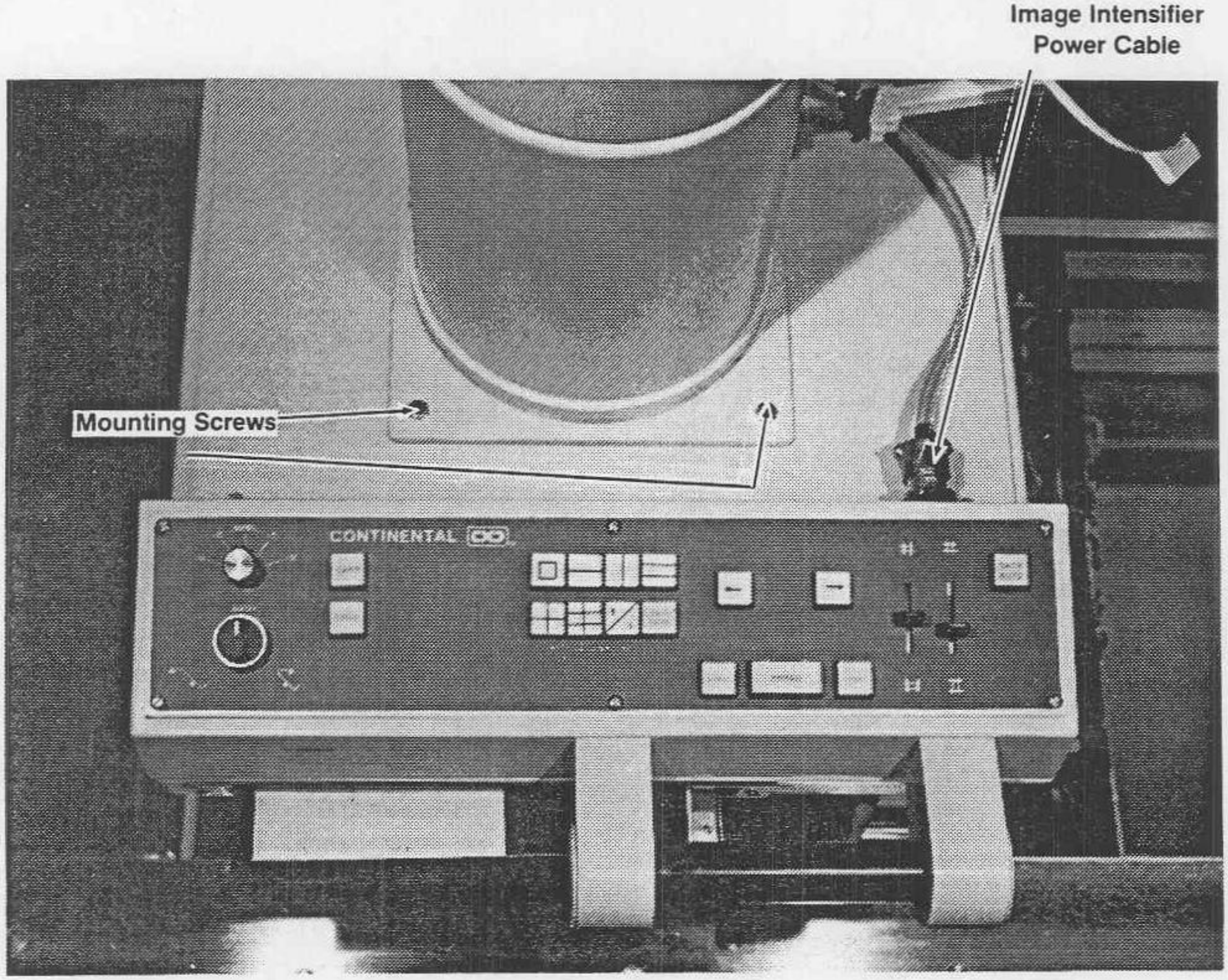


Image Intensifier Power Cable
Mounting Screws
CONTINENTAL

FIGURE 1-23 IMAGING INTENSIFIER SYSTEM PLACEMENT

1.14 ELECTRICAL CONNECTIONS

The CS-8952 system can be operated on 277 volts AC 140 amps, 240 volts AC 160 amps, and 208 volts AC 180 amps, 50 or 60 Hz, single-phase sources.

For source-to-shelter distances of up to 100 feet (30.5 meters), use AWG 2 copper wire; distances of 100 to 150 feet (45 meters), use AWG 1/0 copper wire; 150 feet to 200 feet (61 meters), use AWG 2/0 copper wire; and 200 to 300 feet (76 meters), use AWG 4/0 copper wire.

Use an 18 gauge wire to ground the table.

To install the electrical system, connect each labeled and color-coded cable to the matching plug connector.

The table connect is located on the table leg base at the rear of the table. The auxiliary box connect is located on top of the high voltage transformer.

All cables are terminated with Cannon plugs and are clearly labeled by their symbol numbers (J1, J2, etc.) and a color code matching the plug connectors. Accordingly, J1 connects to P1; J2 to P2; etc.

Although some colors may be duplicated, J (JACK) and P (PLUG) numbers are not.

FIGURES 1-24 and **1-25** show that the cables that connect the generator main control to the high voltage (HV) transformer do not connect to the table connect box.

The high voltage cables connect directly from the high voltage transformer to the x-ray tubes.

Before connecting the tubestand cables to the auxiliary box, make sure these cables are routed through the opening at the East end of the floor rail and pulled taut to allow unobstructed longitudinal travel of the tubestand.

The installation of all system cables, with the exception of the over-table x-ray tube and collimator, should be complete at this time.

1.15 OVER-TABLE X-RAY TUBE INSTALLATION

At least two (2) persons will be needed to perform the steps that follow.

Unpack the over-table x-ray tube (1.0, 2.0 focal spot). X-ray tube mounting hardware is attached to the x-ray tube.

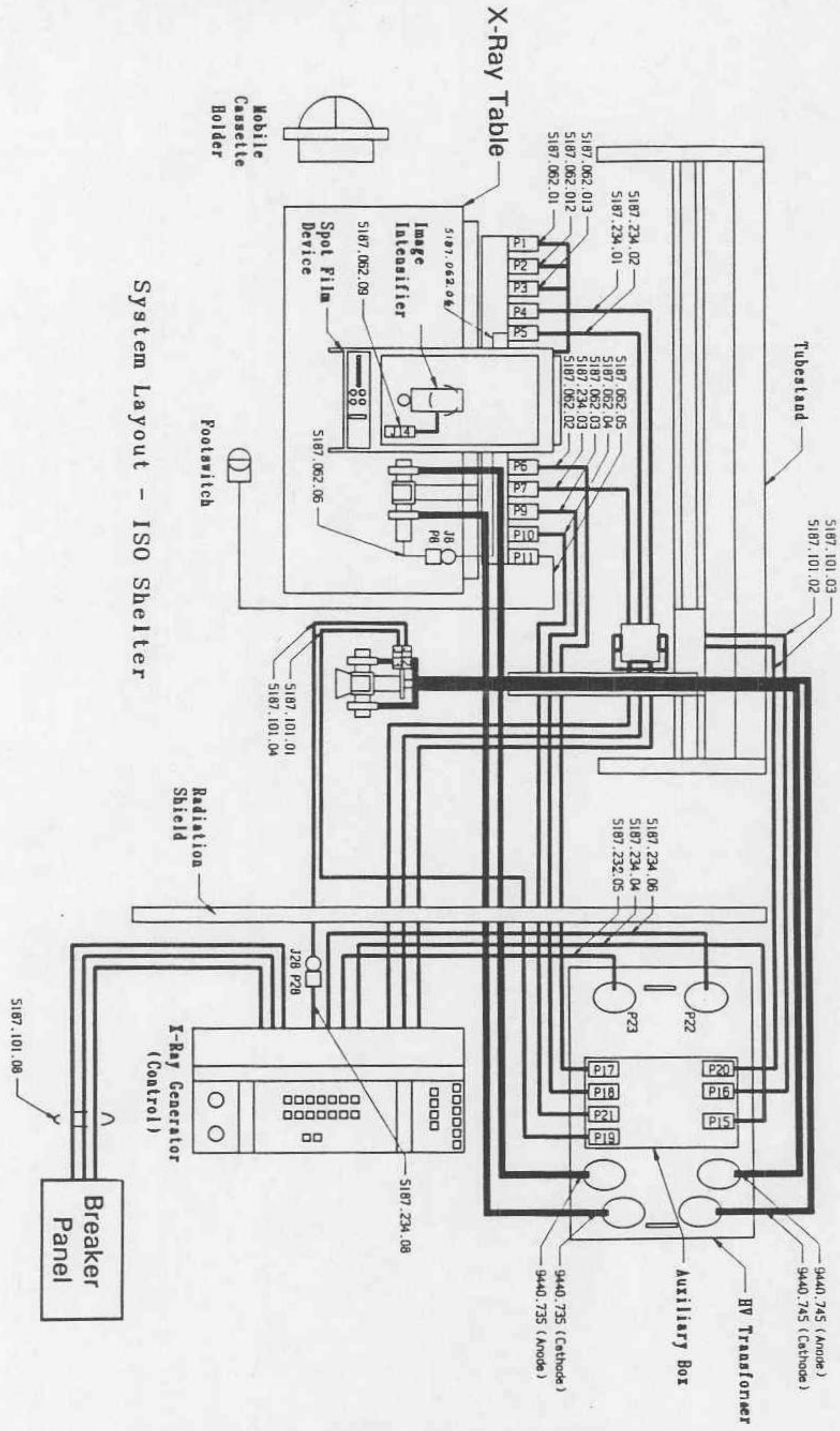

X-Ray Table
Mobile Cassette Holder
5187.062.013
5187.062.012
5187.062.01
5187.234.02
5187.234.01
P1
P2
P3
P4
P5
5187.062.04
Image Intensifier
5187.062.09
Spot Film Device
J14
5187.062.05
5187.062.04
5187.062.03
5187.234.03
5187.062.02
P6
P7
P9
P10
P11
J8
P8
5187.062.06
Footswitch
Tubestand
5187.101.03
5187.101.02
5187.101.01
5187.101.04
Radiation Shield
5187.234.06
5187.234.04
5187.232.05
P22
P23
P17
P18
P21
P19
P20
P16
P15
J28
P28
X-Ray Generator (Control)
5187.101.08
Breaker Panel
5187.234.08
9440.735 (Cathode)
9440.735 (Anode)
Auxiliary Box
HV Transformer
9440.745 (Anode)
9440.745 (Cathode)
System Layout - ISO Shelter

FIGURE 1-24 SYSTEM LAYOUT, ISO SHELTER

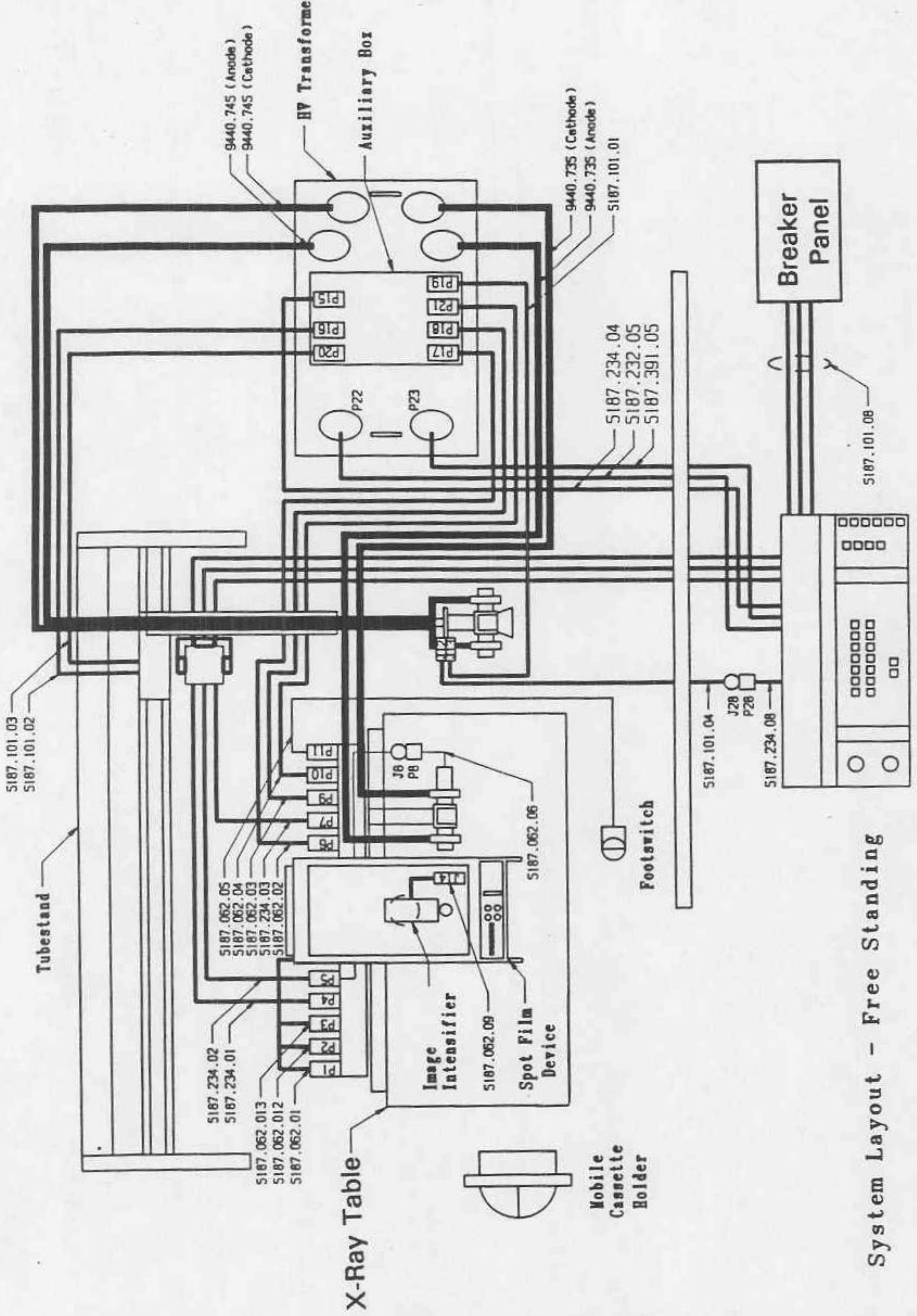

9440.745 (Anode)
9440.745 (Cathode)
HV Transformer
Auxiliary Box
9440.735 (Cathode)
9440.735 (Anode)
5187.101.01
P15
P16
P20
P19
P21
P18
P17
P22
P23
5187.234.04
5187.232.05
5187.391.05
Breaker Panel
5187.101.08
X-Ray Generator (Control)
5187.101.04
J28
P28
5187.234.08
Footswitch
5187.062.06
J8
P8
P11
P10
P9
P7
P6
P14
5187.062.05
5187.062.04
5187.062.03
5187.234.03
5187.062.02
Tubestand
5187.101.03
5187.101.02
P5
P4
P3
P2
P1
5187.234.02
5187.234.01
5187.062.013
5187.062.012
5187.062.01
Image Intensifier
5187.062.09
Spot Film Device
X-Ray Table
Mobile Cassette Holder
System Layout - Free Standing

FIGURE 1-25 SYSTEM LAYOUT, FREESTANDING

1.15 OVER-TABLE X-RAY TUBE INSTALLATION (continued)

NOTE:

While one person installs the over-table x-ray tube, a second person must hold the tube carriage at an accessible height.

A split ring is held in place around the collimator mounting flange by a hex socket screw on the top of the collimator.

Remove the screw, separate the ring halves and lift the mounting ring from the collimator.

Rotate the tube carriage so that the carriage tube mounting surface faces upward. Have another person hold the carriage in this position.

Locate the collimator upper swivel ring that is clamped to the collimator via the split ring. Remove the four screws holding the tube mount spacers to the tube.

CAUTION:

The x-ray tube may fall from the tubestand before its retaining screws are installed.

Since it weighs approximately 42 pounds (20 kg), have another person hold it in place while performing the steps that follow.

Position the x-ray tube on the tubestand with the port facing down. Have one tube mount spacer (1/16" thick) between the x-ray tube mounting surface and the tubestand mount.

Make sure that the cable sockets point toward the vertical column. Attach the tube to the tubestand with the four screws provided, through the collimator ring and a second tube mount spacer.

Connect the tube's rotor cable to its plug connector, on the bracket at the left rear of the tube carriage **(as viewed from the front)**.

Connect the anode cable to the anode cable port and the cathode cable to the cathode cable port.

Make sure these cables are routed such that the tube assembly can "roll" ± 180° from "port" down position (the cables were routed correctly at the factory).

Let this assembly rotate, via gravity, so that the x-ray tube is down (port up).

1.15.1 OVER-TABLE COLLIMATOR INSTALLATION

CAUTION:

The collimator can easily fall from the tubestand before its retaining rings are installed.

Since it weighs approximately 19 pounds (8.5 kg), have another person hold it in place while performing the steps that follow.

While one person installs the over-table collimator, a second person must hold the tube carriage at an accessible height.

Remove the cover that protects the collimator blades. Be very careful with the small blades on the collimator because they are easily damaged.

Turn the collimator upside down and position it on its upper swivel ring mounted in **Section 1.15** (see **FIGURE 1-21**). Make sure that its front panel faces away from the vertical column.

Install the split ring around the collimator lower swivel ring and upper swivel ring. The hinge of the split ring must line up with the pin in the lower swivel ring. Be sure the screw is tight.

Position the collimator so that it is "square" with the x-ray tube and tighten the lock screw in the split ring that screws into notches in the upper swivel ring and the lower swivel ring.

The collimator should now be locked in place.

Connect the collimator cable to its plug connector on the bracket at the left rear of the tube carriage.

The column can be leveled by placing the spirit level on the column rails and adjusting the four leveling screws on the ends of the main frame.

The accuracy of leveling should be checked with the column at both end positions as well as in the center of the rail.

To facilitate setting the leveling screws, it is recommended that the column be moved to the opposite end of the rail.

Once the rail is determined to be level, tighten the screws on the floor mounting brackets.

1.16 LEVELING THE TABLE AND PLUMBING THE TOWER

> **NOTE:**
>
> The table is completely aligned before it leaves the factory. This is critical since the table is the foundation for the associated radiographic/fluoroscopic system. The accuracy of the system is dependent upon the table.
>
> All table adjustments must be completed before other system components can be aligned and calibrated.

Table alignment adjustments may be disturbed when the equipment is transported or during installation. The procedures in this paragraph consist of confirming the alignment, and checking the table installation each time the system is relocated or reinstalled.

Table alignment consists of ensuring that the table top carriage is level and that the tower is plumb. This alignment also ensures that the spot film device (SFD), under-table collimator, and intensifier imaging system are properly oriented in preparation for their own alignments.

Turn on power and tilt the table up several degrees and then tilt it down to horizontal stop position.

Use the spirit level along the front edge of the table top frame and across the width of the table top frame at the foot end to determine the amount and direction that the table is out of level.

Use the four leveling screws in the table leg to level the table, as needed. Use the spirit level, as necessary, to determine when the table is level.

> **If the table is secured to the baseplate or floor, it may be necessary to loosen the mounting bolts before adjusting the leveling screws.**

Tighten the mounting bolts when the table is level in all directions. Make sure that the table body is not tilted toward the head or foot end.

Use the spirit level on the rails of the tower to determine the direction that it is out of plumb.

The tower rests on or is guided by, seven eccentric bearing assemblies held in position by hex socket cap screws (A, B, C, D Bearing Blocks, **FIGURE 1-26**).

Rotating these eccentric bearing assemblies permits tower adjustment by shifting it right, left, up, or down, depending on the axis of the eccentric bearing being turned.

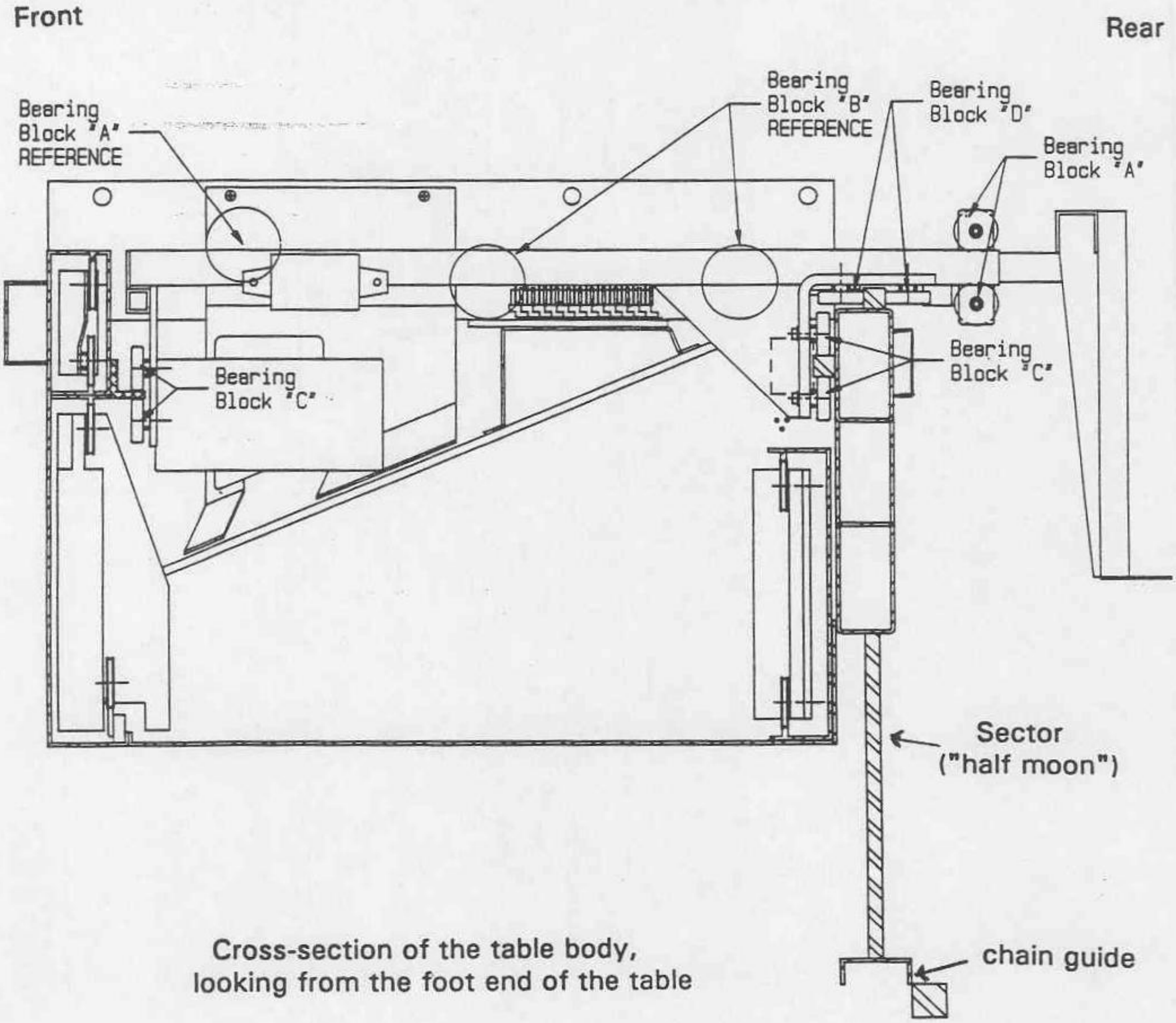

Front
Rear
Bearing Block "A" REFERENCE
Bearing Block "B" REFERENCE
Bearing Block "D"
Bearing Block "A"
Bearing Block "C"
Bearing Block "C"
Sector ("half moon")
chain guide
Cross-section of the table body, looking from the foot end of the table

FIGURE 1-26 ECCENTRIC BEARINGS FOR PLUMBING THE TABLE TOWER

1.16 LEVELING THE TABLE AND PLUMBING THE TOWER (continued)

Plumb the tower by loosening the hex socket cap screws and use an open end wrench to rotate the "loaded" eccentric bearing assemblies to the required position.

Note that the unloaded eccentric bearing at this position may have to be "loosened" to allow its mate to be adjusted.

Verify that the tilt angulator is set correctly.

The tilt indicator on the front of the table must be aligned with the vertical indentation on the table body (above the indicator dial).

To adjust, rotate the dial until red line on the dial is directly aligned with the indentation.

1.17 TABLE OPERATIONAL CHECK

Refer to Volume II, Table Chapter of this manual and perform the Operational Check for the table.

Verify that all lights, switches and locks are functional.

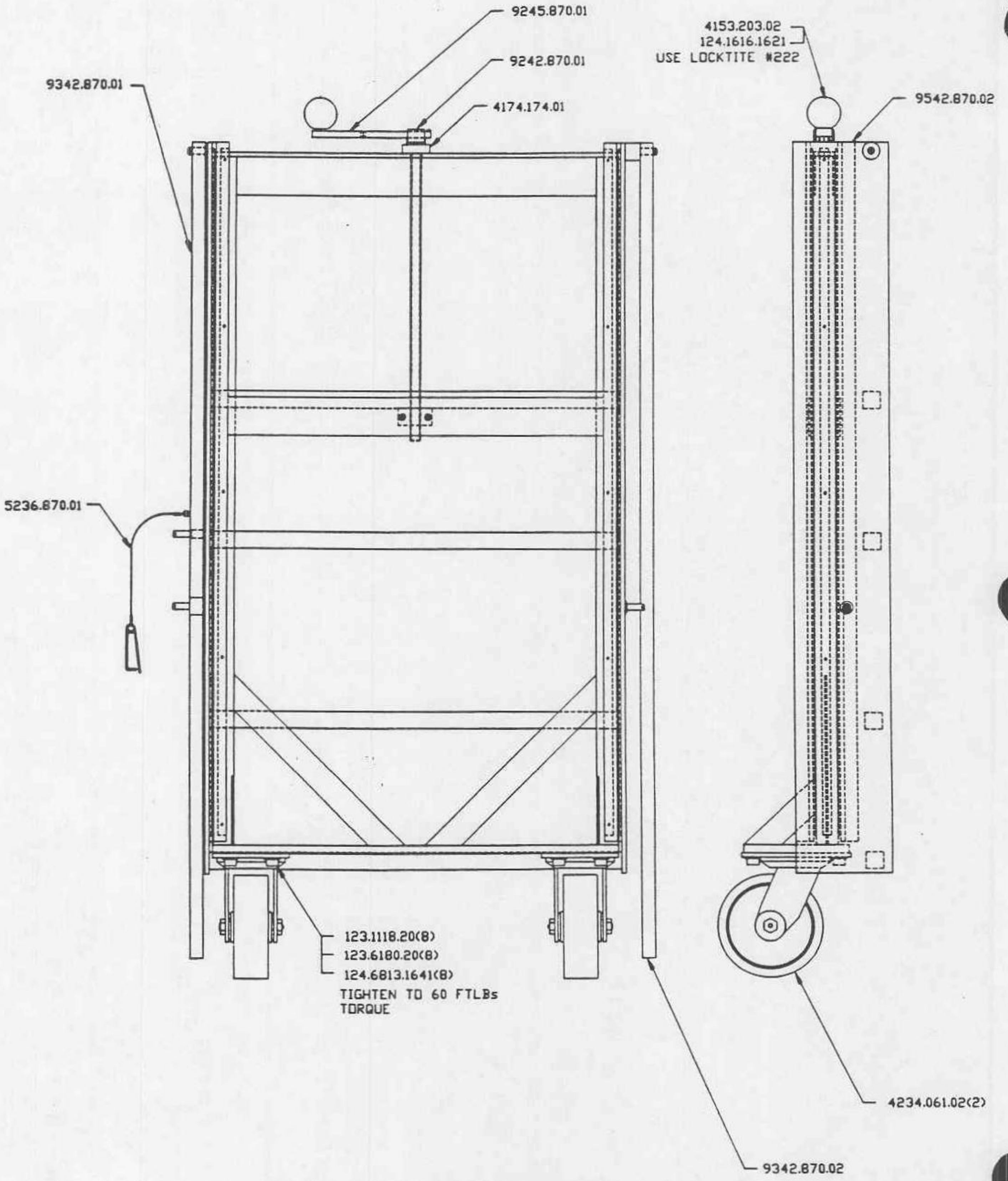
NOTE:

Do not install the table top and sub-top until the system has been calibrated.

SECTION 2 - TRANSPORT DEVICE PARTS LIST

1.	121.0632.0527	6-32 X 3/8 Flat Steel Philips Screw	26	EA
2.	121.0832.0890	8-32 x 1/2 Stnlss Steel Thumb Screw	2	EA
3.	121.8632.1029	6-32x 5/8 Flat Phillip Hd St Stl	4	EA
4.	122.0632.42	6-32 Elastic Stop Nut	4	EA
5.	123.1118.20	17/32Id 17/16Od 3/32T Stl Sae Washr	8	EA
6.	123.6140.20	1/4 Internal Tooth Steel Lockwasher	4	EA
7.	123.6180.20	1/2 Internal Tooth Steel Lockwasher	8	EA
8.	124.1616.1621	3/8-16 X 1 Sckt Hd St Scrw Cup Pt	1	EA
9.	124.6420.0842	1/4-20 X 1/2 Socket Head Cap Screw	4	EA
10.	124.6813.1641	1/2-13 X 1 In Sckt Hd Cap Screw	8	EA
11.	137.9101.20	1/16 X 2 Adhesive Felt	1.75	FT
12.	4129.870.02	MTD 5/8-11 Threaded Lifting Bar	1	EA
13.	4153.203.02	1-15/16" Diameter Black Knob	1	EA
14.	4174.174.01	5/8 ID 1-5/8 OD Thrust Bearing	1	EA
15.	4234.061.02	6x2 Swivel Caster 1200 Lb Cap PolyU	2	EA
16.	4359.870.01	MTD Guide Bearing Strip	6	EA
17.	5236.870.01	MTD Sfty Pin & Cable Asm, Cross Arm	1	EA
18.	5236.870.02	MTD Safety Pin & Cable Assembly	4	EA
19.	9242.870.01	MTD 5/8 Acme Thrd Rod & Nut Wldmnt	1	EA
20.	9242.870.03	MTD Transformer Spacer Tie Bar	1	EA
21.	9245.870.01	MTD Crank Arm Weldment	1	EA
22.	9342.870.01	MTD LS Cross Bar & Lctng Pin Wldmnt	1	EA
23.	9342.870.02	MTD Right Side Cross Bar Weldment	1	EA
24.	9542.870.01	MTD Main Frame Weldment	1	EA
25.	9542.870.02	MTD Main Vertical Frame Weldment	1	EA

TABLE 2-1 PARTS LIST: TRANSPORT DEVICE


9245.870.01
9242.870.01
4174.174.01
9342.870.01
4153.203.02
124.1616.1621
9542.870.02
5236.870.01
123.1118.20(8)
123.6180.20(8)
124.6813.1641(8)
4234.061.02(2)
9342.870.02

USE LOCKTITE #222

TIGHTEN TO 60 FTLBs TORQUE

FIGURE 2-1 TRANSPORT DEVICE, VIEW 1

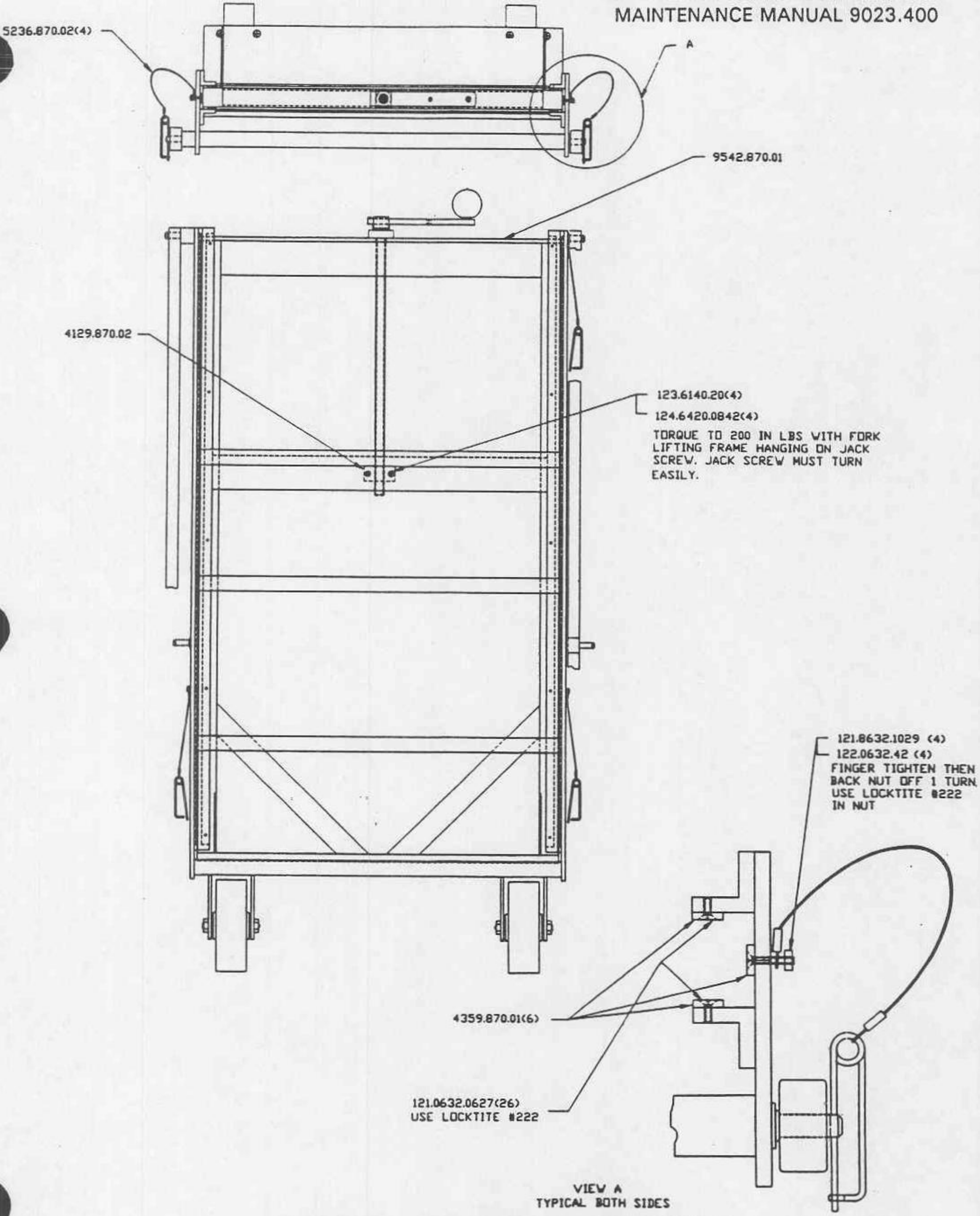

5236.870.02(4)
A
9542.870.01
4129.870.02
123.6140.20(4)
124.6420.0842(4)
TORQUE TO 200 IN LBS WITH FORK LIFTING FRAME HANGING ON JACK SCREW. JACK SCREW MUST TURN EASILY.
121.8632.1029 (4)
122.0632.42 (4)
FINGER TIGHTEN THEN BACK NUT OFF 1 TURN. USE LOCKTITE #222 IN NUT
4359.870.01(6)
121.0632.0627(26)
USE LOCKTITE #222
VIEW A
TYPICAL BOTH SIDES

FIGURE 2-2 TRANSPORT DEVICE, VIEW 2

NOTES

SECTION 3 - ISO-SHELTER SHIPPING FIXTURES

3.0 INSTALLATION OF SHIPPING FIXTURES IN ISO-SHELTER

This section provides instructions on how to install the shipping fixtures provided for the CS-8952 Field Deployable X-ray System, when installed in an ISO-shelter.

The shipping fixtures provide additional protection from shipping damage. They will also reduce the time required for preparing the system for use after shipping, and the time required for preparation for shipping.

3.1 BILLS OF MATERIAL FOR SHIPPING FIXTURES

See **FIGUREs 3-1 and 3-2, and TABLEs 3-1 and 3-2** for illustrations of the shipping fixtures, and a listing of the part numbers of the components in the shipping fixture assemblies.

3.2 TUBESTAND BASE PLUNGER ASSEMBLY

See **FIGURE 3-1**. If there is a shipping bracket at the foot end of the tubestand rail, remove. Locate two holes in the tubestand carriage mount, over the top guide rail.

Attach the Tubestand Base Plunger Assembly (5197.873.08) in the two holes, using the hardware attached, loosely.

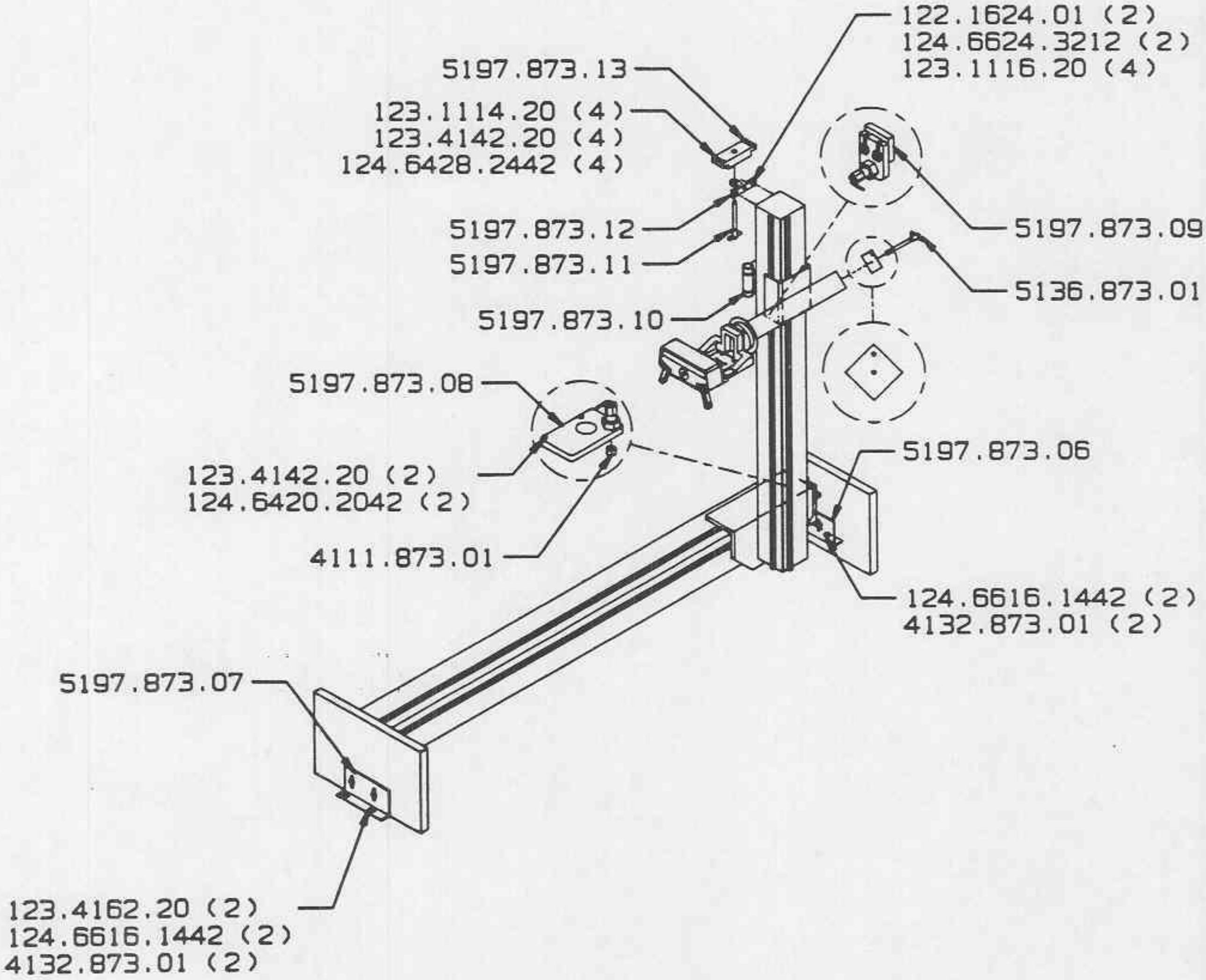
Slide the tubestand to the head end of the table. Using a 1/4" allen wrench, remove the farthest screw at the foot end of the top guide rail.

Replace the screw with Insert Plunger Bushing Main Frame Rail (4111.873.01) and secure in hole with Loctite #271.

Align locking pin in bracket with tubestand hole insert. When aligned, tighten screws in bracket.

Part Number	Description
122.1624.01	3/8-24 Elastic Stop Nut
123.1114.20	9/32 ID 5/8 OD 1/16 Thick Steel SAE Washer
123.1116.20	13/32 ID 13/16 OD 1/16 Thick Steel SAE Washer
123.4142.20	1/4 Medium Pattern Split Lockwasher
123.4162.20	3/8 Medium Pattern Split Lockwasher
124.6420.2042	1/4-20 x 1-1/4 Socket Head Cap Screw
124.6428.2442	1/4-28 x 1-1/2 Socket Head Cap Screw
124.6616.1442	3/8-16 x 7/8 Socket Head Cap Screw
124.6624.3212	3/8-24 x 2 Hex Head Cap Screw
4111.873.01	Plunger Bushing Main Frame Rail
4132.873.01	13/32 ID 3/4 OD 13 Gauge Steel Washer
5136.873.01	Tube Arm Extension Shipping Lock Assembly
5197.873.06	Tubestand Right Hand Bracket Assembly
5197.873.07	Tubestand Left Hand Bracket Assembly
5197.873.08	Tubestand Base Plunger Assembly
5197.873.09	Tubestand Vertical Carriage Plunger Assembly
5197.873.10	Tubestand HV Cable Support Assembly
5197.873.11	Tubestand Lock Pin Assembly
5197.873.12	Tubestand Top Mount Assembly
5197.873.13	Tubestand Ceiling Mount Assembly

TABLE 3-1 TUBESTAND ISO-SHELTER SHIPPING PARTS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123.4142.20 (4)
124.6428.2442 (4)
5197.873.09
5197.873.12
5197.873.11
5136.873.01
5197.873.10
5197.873.08
5197.873.06
123.4142.20 (2)
124.6420.2042 (2)
4111.873.01
124.6616.1442 (2)
4132.873.01 (2)
5197.873.07
123.4162.20 (2)
124.6616.1442 (2)
4132.873.01 (2)

FIGURE 3-1 TUBESTAND SHIPPING FIXTURES

3.3 TUBESTAND UPPER LOCKING ASSEMBLY

NOTE:
Before proceeding with the following step, be sure the tubestand is perpendicular using level.

See **FIGURE 3-1**. At the top of the tubestand column, remove the top cover and attach the Tubestand High Voltage Cable Support Assembly (5197.873.10) and Tubestand Top Mount Assembly (5197.873.12) with hardware provided.

Move the tubestand to its shipping position (foot end) and lock it with the spring loaded pin in assembly 5197.873.08 (see **FIGURE 3-1**).

Insert the Tubestand Lock Pin Assembly (5197.873.11) as indicated, into the Tubestand Top Mount Assembly. Position the Tubestand Ceiling Mount Assembly (5197.873.13) under the pin, and insert the pin in the mount.

With a grease pencil, mark the location of the bracket on the ceiling. Move the tubestand to the head end. Drill four holes as indicated. Using the special ISO-shelter tool required, mount four inserts with epoxy.

NOTE:
The epoxy MUST dry for 48 hours before using.

After the epoxy has dried, install the Tubestand Ceiling Mount Assembly with hardware provided. Verify that the spring-loaded pin will easily align with the ceiling bracket, and adjust the tubestand column bracket mount and tubestand ceiling mount assembly as required.

3.4 TUBESTAND VERTICAL CARRIAGE PLUNGER ASSEMBLY

See **FIGURE 3-1**. On the tubestand column, locate the front guide rail. The rail is attached to the column with 13 screws. Locate the 3rd screw from the top and remove. On the bottom of the tubestand arm, locate the two bearings that ride on the tubestand column guide rail. Carefully, remove the two screws that hold the bearings in place, while holding the bearings in position with your other hand. If necessary, wedge the bearings in place so they won't drop.

Position the Tubestand Vertical Carriage Assembly (5197.873.09) over the holes in the column and install the bearing eccentric assemblies using the same hardware, using Loctite #271 to secure.

Using the "bearing adjusting tool", adjust for proper bearing movement. Align so that the spring-loaded pin will lock in the hole where the screw was removed. Tighten.

3.5 TUBESTAND BASE PLUNGER ASSEMBLY

Locate the Tubestand Base Plunger Assembly, 5197.873.08 (see **FIGURE 3-1**). If there is a shipping bracket at the foot end of the tubestand rail, remove it. Locate two holes in the tubestand carriage mount, over the top guide rail. Loosely attach the 5197.873.08 plunger in the two holes, using the hardware attached.

Slide the tubestand to the head end of the table. Remove the farthest screw at the foot end of the top guide rail. Replace the screw with the Insert Plunger Bushing Main Frame Rail, 4111.873.01. Secure with Loctite #271. Align locking pin in bracket with tubestand hole insert. When aligned, tighten screws in bracket.

3.6 TABLE HEAD END AND FOOT END SUPPORT ASSEMBLY

See **FIGUREs 3-2** and **3-3**. The table is shipped with the head end and foot end shipping fixtures mounted to the base plate, and supporting the table. Verify the alignment of all components correctly in the ISO-shelter.

Swing both fixtures up to shipping position. If the table is too low for the fixtures to clear, do the following:

CAUTION!
Be sure power is turned off and the circuit breaker
disconnected before performing the following steps.

1. with the covers removed on the table leg, locate the motor drive belt. Turn the belt by hand to tilt the table slightly, enough to clear fixture.

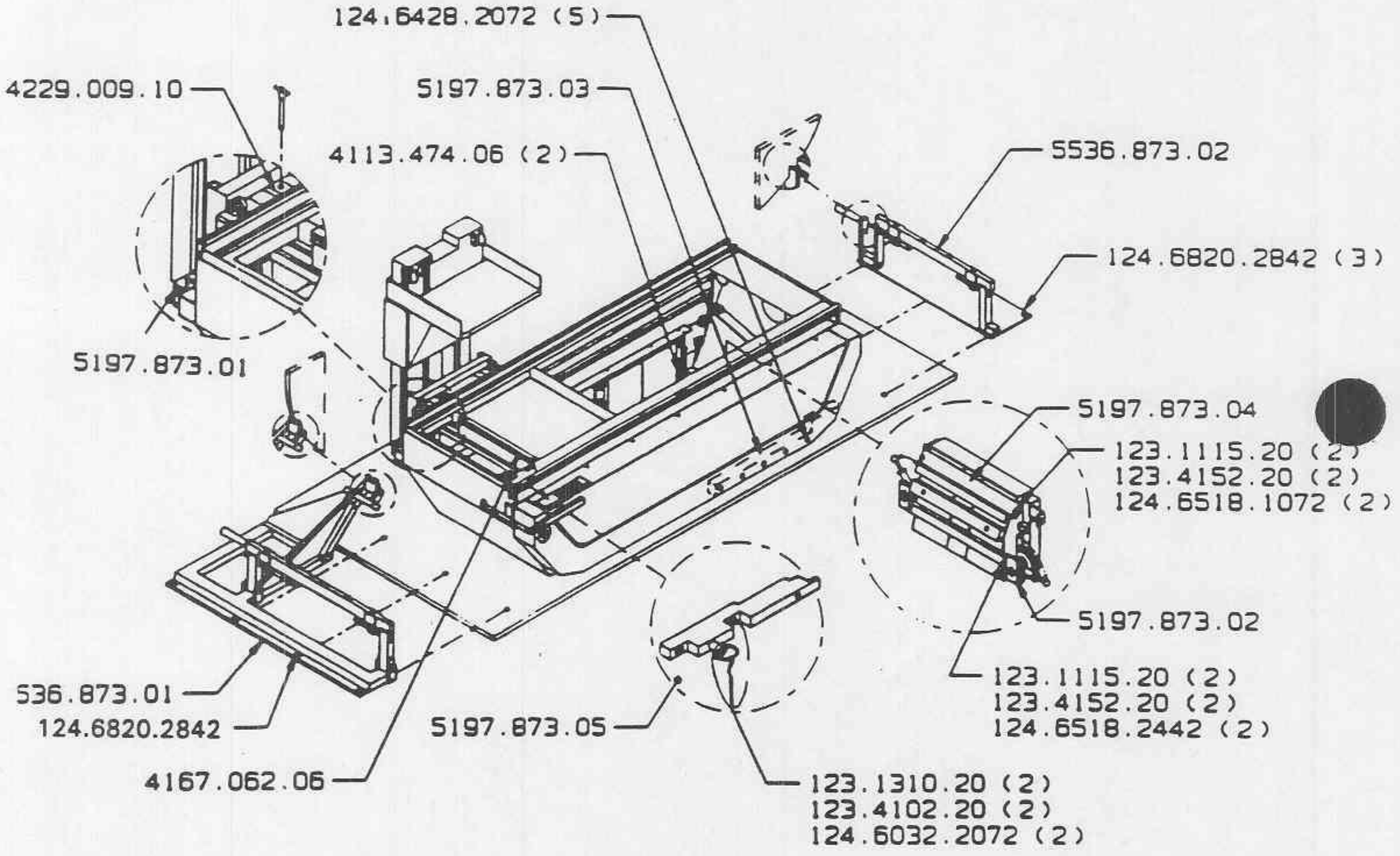
2. loosen the screws on the table leg, and gently jog the table into proper position. Tighten screws in table leg.

Align and release the spring-loaded pins into the holes in the table bottom. On the left side of the head end fixture is the "chain guide shipping support cradle". When positioned correctly, the cradle will fit securely around the edge of the chain guide.

When both fixtures are positioned at both ends and the chain guide cradle is correctly positioned, and the spring-loaded pins are in shipping position, tighten the bolts in both ends of the base plate **all the way**.

3.7 MOUNT TWO-SIDED SHIPPING FIXTURE POSTER TO ISO-SHELTER WALL

Using the double-sided velcro supplied, attach the poster on a convenient area on the wall behind the tubestand.


124.6428.2072 (5)
4229.009.10
5197.873.03
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5536.873.02
124.6820.2842 (3)
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5197.873.04
123.1115.20 (2)
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124.6518.2442 (2)
4167.062.06
123.1310.20 (2)
123.4102.20 (2)
124.6032.2072 (2)

FIGURE 3-2 TABLE SHIPPING FIXTURES, PART NUMBERS

3.3 TUBESTAND UPPER LOCKING ASSEMBLY

> NOTE:
> Before proceeding with the following step, be sure the tubestand is perpendicular using level.

See **FIGURE 3-1**. At the top of the tubestand column, remove the top cover and attach the Tubestand High Voltage Cable Support Assembly (5197.873.10) and Tubestand Top Mount Assembly (5197.873.12) with hardware provided.

Insert the Tubestand Lock Pin Assembly (5197.873.11) as indicated, into the Tubestand Top Mount Assembly. Position the Tubestand Ceiling Mount Assembly (5197.873.13) under the pin, and insert the pin in the mount.

With a grease pencil, mark the location of the bracket on the ceiling. Move the tubestand to the head end. Drill four holes as indicated. Using the special iso shelter tool required, mount four inserts with epoxy.

> NOTE:
> The epoxy MUST dry for 48 hours before using.

After the epoxy has dried, install the Tubestand Ceiling Mount Assembly with hardware provided. Verify that the spring-loaded pin will easily align with the ceiling bracket, and adjust the tubestand column bracket mount and tubestand ceiling mount assembly as required.

3.4 TUBESTAND VERTICAL CARRIAGE PLUNGER ASSEMBLY

See **FIGURE 3-1**. On the tubestand column, locate the front guide rail. The rail is attached to the column with 13 screws. Locate the 3rd screw from the top and remove.

On the bottom of the tubestand arm, locate the two bearings that ride on the tubestand column guide rail. Carefully, remove the two screws that hold the bearings in place, while holding the bearings in position with your other hand. If necessary, wedge the bearings in place so they won't drop.

Position the Tubestand Vertical Carriage Assembly (5197.873.09) over the holes in the column and install the bearing eccentric assemblies using the same hardware, using (removable) Loctite 242 to secure.

Using the "bearing adjusting tool", adjust for proper bearing movement. Align so that the spring-loaded pin will lock in the hole where the screw was removed. Tighten.

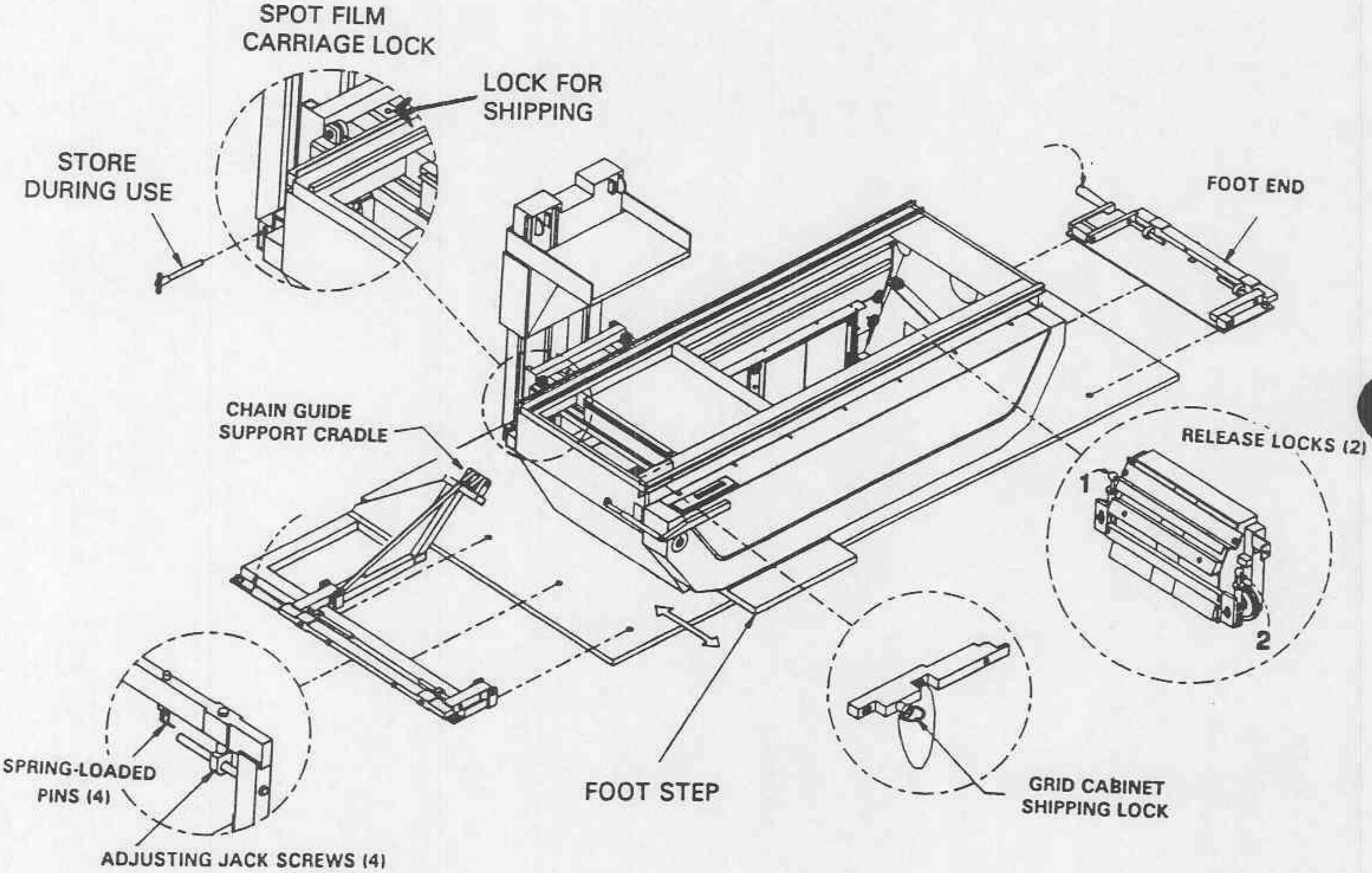

SPOT FILM CARRIAGE LOCK
LOCK FOR SHIPPING
STORE DURING USE
FOOT END
CHAIN GUIDE SUPPORT CRADLE
RELEASE LOCKS (2)
1
2
SPRING-LOADED PINS (4)
ADJUSTING JACK SCREWS (4)
FOOT STEP
GRID CABINET SHIPPING LOCK

FIGURE 3-3 TABLE SHIPPING FIXTURES, CALL-OUTS

SECTION 4 - PREPARE ISO-SHELTER FOR USE

4.1 ISO-SHELTER PREPARATION

The ISO-shelter is designed to have its contents permanently installed in one-half of its "full open" space.

This area compresses to half size for transport, by folding in half of the outer walls.

The ISO-shelter "DEPMEDS" system is designed to require minimal time to set up for use.

The following steps describe the procedures to re-install the components that were removed for transport, as well as the procedures to release all shipping locks and shipping fixtures, which prevent required movements for all component parts.

4.2 TABLE TOP REMOVAL

See the instructions in **Section 1.9.3** of this chapter for table top and sub-top removal.

4.3 INSTALLATION OF THE UNDER-TABLE COLLIMATOR AND X-RAY TUBE

1. Locate the case containing the under-table collimator (Linear FSE). Locate the under-table x-ray tube (RAD-14). Save the containers for re-use.

2. For installation of the under-table tube and collimator, reference **Section 1.12** of this chapter.

4.4 TABLE PREPARATION

See **FIGURE 3-3.**

1. Extend the foot step out 2" or 3", to allow the step 2 to be performed.

2. At the head end, remove the jack screw handles from the holes on the sides of the support frame.

   Turn the jack screws to lower the table onto its bearings, until the support frame clear the table bottom.

   Swing the head end support down.

   Repeat for the foot end support frame.

3. Push the foot step back in.

4. Insert the locking pin of the grid cabinet into the hole marked "Operational Position". The grid cabinet should move freely.

5. Remove the locking pin from the spot film carriage location marked "Shipping Position" and store in location marked "Operational Position".

6. The counterweight at the (inside) front of the table has two spring loaded release locks.

   Pull up on the collar and pull the handle to a fully upright position, on both sides.

   The spot film device carriage should move freely in the longitudinal direction.

4.5 TUBESTAND PREPARATION

See **FIGURE 4-1.**

1. Release and lower the spring loaded pin from the ceiling bracket until the tubestand is free of the ceiling bracket.

   The pin will remain suspended in the lowered position.

2. Release the velcro strips that prevent tube rotation.

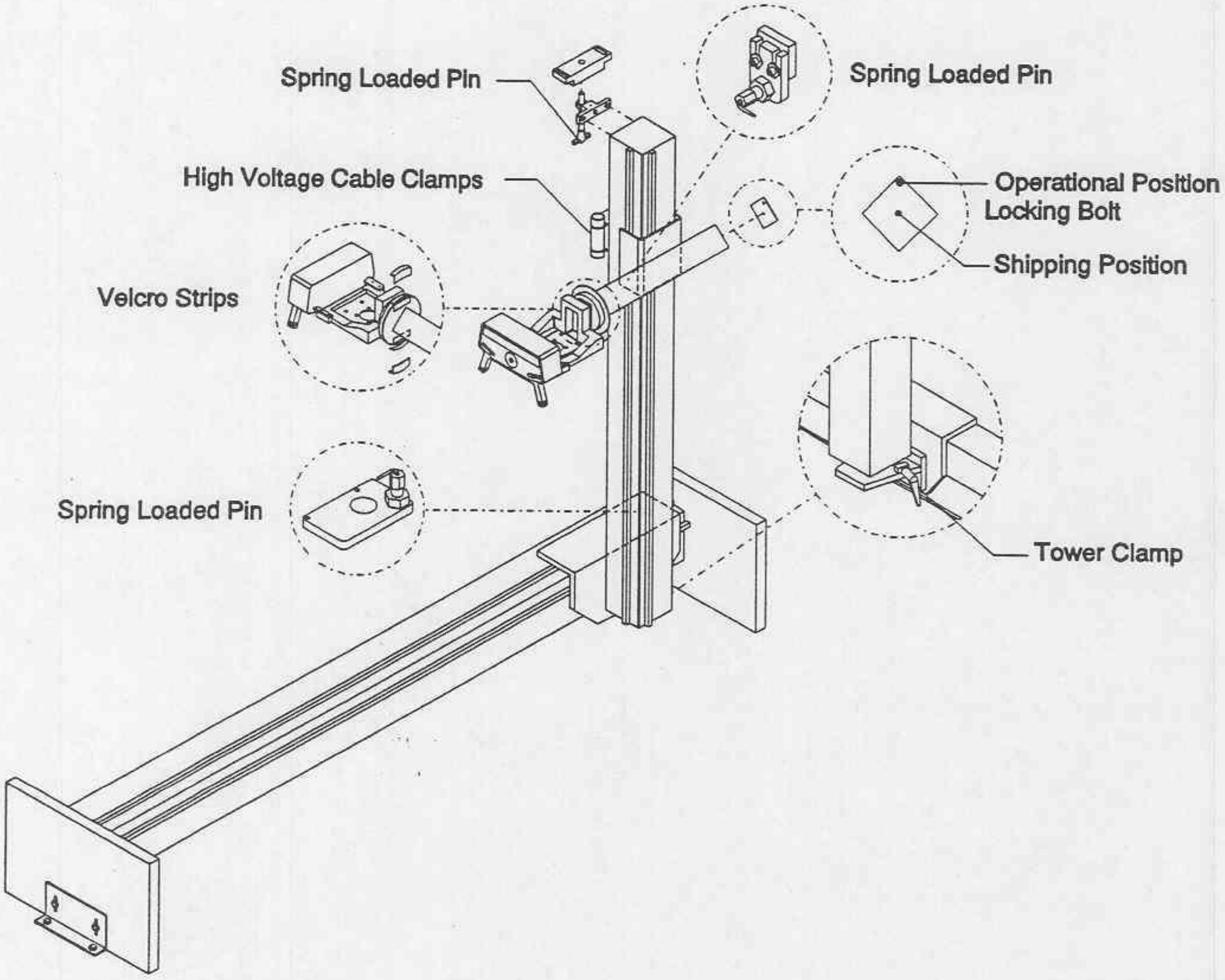

Spring Loaded Pin
Spring Loaded Pin
High Voltage Cable Clamps
Operational Position
Locking Bolt
Shipping Position
Velcro Strips
Spring Loaded Pin
Tower Clamp

FIGURE 4-1 TUBESTAND SHIPPING LOCKS

4.5 TUBESTAND PREPARATION (continued)

3. Remove the bolt that locks the rotational movement of the tube arm from the hole marked "Shipping Position" and place in the hole marked "Operational Position".

4. Turn the handle of the spring loaded pin, at the base of the vertical column of the tube stand, to unlock the column. The tube stand should move freely horizontally.

5. Turn the handle of the spring loaded pin at the top of the tower to allow the tube arm to raise and lower.

6. Turn the black handle of the tower clamp at the tower base to allow free rotation of the tower.

4.6 INSTALLATION OF THE OVER-TABLE COLLIMATOR AND X-RAY TUBE

1. Locate the case containing the over-table collimator (Linear 2). Locate the under-table x-ray tube (RAD-13). Save the containers for later use.

2. For installation of the under-table tube and collimator reference **Section 1.15** of this chapter.

4.7 INSTALLATION OF THE SPOT FILM DEVICE AND THE IMAGE INTENSIFIER

1. Locate the boxes containing the Spot Film Device (SFD) and the Image Intensifier (I.I.). Before attempting to assemble, remove all mounting hardware from their transport positions for reinstallation in the equipment during assembly. Save the containers for use later when the system is broken down for transport.

2. For installation of these assemblies reference **Section 1.13** of this chapter.

NOTE:

Do not install the table top or the sub-top until calibration is complete.

SECTION 5 - PREPARE ISO-SHELTER FOR TRANSPORT

5.0 PREPARATION FOR SHIPPING

This section provides instructions for preparing the CS-8952 x-ray system for shipping when installed in an ISO-Shelter.

To prevent danger of electrical shock to service personnel, remove all power from the system before beginning the following procedures.

5.1 REMOVAL OF THE IMAGE INTENSIFIER

1. Position the spot film carriage at the head end of the table, align the holes of the carriage and the table and insert the locking pin. This will make removal of the spot film device (SFD) and the image intensifier (I.I.) safer.

2. Lower the carriage assembly to a position which will afford good access to the four mounting screws holding the I.I. to the SFD.

3. Carefully remove the I.I. and place in its shipping container.

5.2 REMOVAL OF THE SPOT FILM DEVICE

1. Push the spot film device (SFD) fully to the rear of the table. Attention must be paid to the locking pin. If it engages while moving the SFD, it must be pulled down out of the stop hole in the SFD.

Remove the bumper stop screw, which is installed in the underside, rear, of the flat rail.

2. Disconnect the cable from the table running to the SFD and ensure it is out of the way.

3. Slide the SFD to a middle position. While supporting the SFD on the bearing block side, remove the screws mounting both bearing blocks to the tower.

Carefully rest the SFD on the carriage side plate. Place the screws in a safe place for reinstallation during transport.

5.2 REMOVAL OF THE SPOT FILM DEVICE (continued)

4. Slide the bearing blocks off the rod, and place with the screws.

WARNING:

- SFD removal requires two persons.
- Do not use the handle for lifting. Injury to personnel and/or damage to the SFD could result.
- Extreme care must be exercised during handling to prevent damage to the compression cone on the underside of the SFD.

Do NOT rest the SFD on the cone.

5. Raise the SFD carefully to clear the carriage assembly. Remove the SFD to the front.

Reinstall the bumper screw in the rail.

6. Place the SFD in its shipping container.

7. Reinstall the bearing blocks in the carriage for transport.

5.3 REMOVAL OF THE OVER-TABLE COLLIMATOR

1. Move the tube arm to a good working height.

2. Disconnect the collimator cable from J13 on the tube arm.

3. While one person holds the collimator to prevent it from falling, have a second person remove the slip ring securing the collimator to the x-ray tube.

4. Reinstall the slip ring on the collimator for transport, and place the collimator in its shipping container.

5.4 REMOVAL OF THE OVER-TABLE X-RAY TUBE

1. Remove the CATHODE and ANODE cables from the x-ray tube, and install the protective covers on the x-ray tube connectors.

2. Disconnect the x-ray tube cable from J12 on the tube arm.

3. Have one person hold the x-ray tube to prevent it from falling.

Have another person remove the hardware securing the upper mounting ring (used to secure the collimator to the underside of the tube arm), and the spacer ring just above it. There is a second spacer ring immediately underneath the x-ray tube.

The x-ray tube can now be removed and stored in its container.

Store the two spacer rings, upper mounting ring, and the screws, in the cloth bag with the tube.

5.5 TABLE TOP REMOVAL

Reference **Section 1.9.3** of this chapter for instructions to remove table top.

5.6 SUB-TOP REMOVAL

Reference **Section 1.9.3** of this chapter for instructions to remove table sub-top.

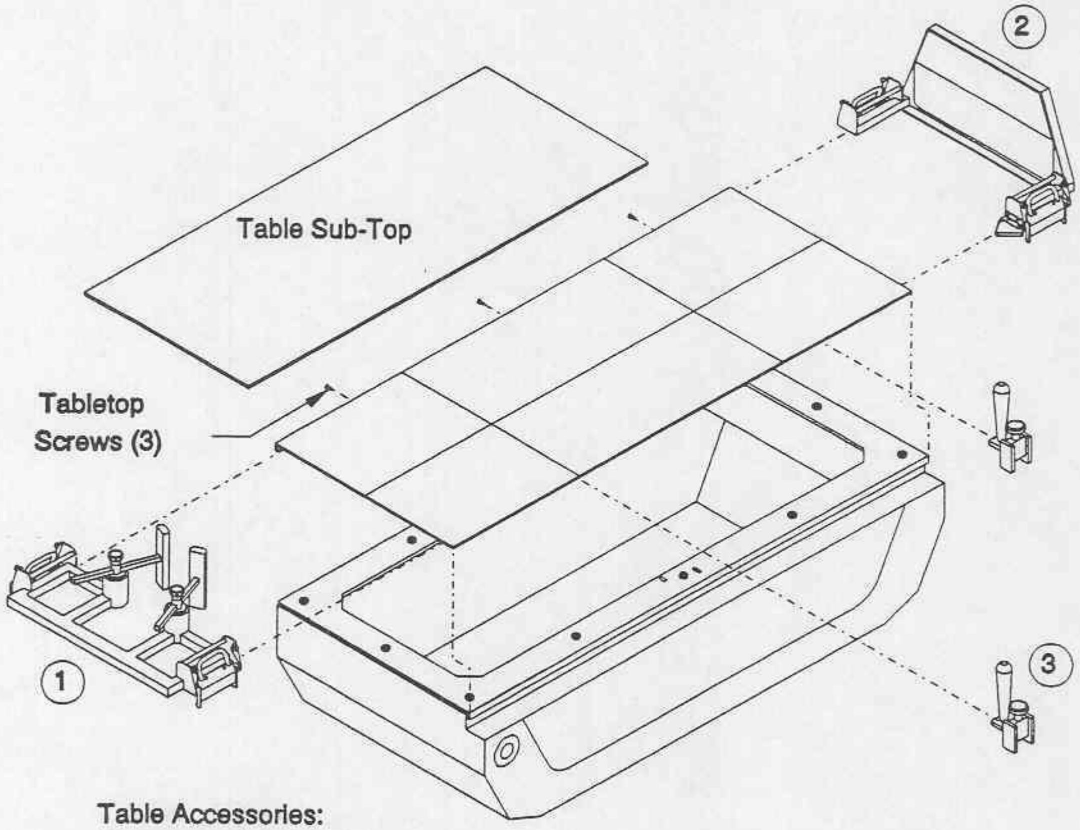


Table Sub-Top
Tabletop Screws (3)
②
①
③

Table Accessories:

1. Shoulder Rest
2. Footrest
3. Handgrips (2)

FIGURE 5-1 TABLE TOP SHIPPING PREPARATION

5.7 REMOVAL OF THE UNDER-TABLE COLLIMATOR

1. Disconnect the collimator cable from its mating cable.

2. Remove the four screws which secure the under-table collimator to the mounting bracket.

3. Lift carefully and remove the under-table collimator. Place in its container for transport.

5.8 REMOVAL OF THE UNDER-TABLE X-RAY TUBE

1. Disconnect the CATHODE and ANODE cables from the x-ray tube and install protective covers on the tube.

2. Disconnect the under-table x-ray cable from its mating cable.

3. Support the x-ray tube while removing the four screws securing it to the mounting bracket. Remove the x-ray tube from the table and replace the four screws for transport.

4. Pack the x-ray tube in the container provided for transport.

5.9 TABLE PREPARATION

Reference **FIGURE 3-3.**

1. Pull the foot step to the front to allow clearance of the shipping fixtures.

2. Swing the head end and foot end shipping fixtures up.

3. Engage the spring loaded pins in the holes in the underside of the table.

4. Turn the jack screws to raise the table about 1/8". This will relieve the bearings of the weight of the table and cradle the bearing track during transport.

5. Secure the jack screw handles in their respective holes in the shipping frames.

6. Push the foot step back into retracted position.

7. Move the spot film carriage to the head end of the table. Align the holes in the carriage with those in the table and insert the locking pin into the hole marked "Shipping Position".

8. There are two release locks on the table front counter-weight (inside the table body), one towards the head end and one towards the foot end.

   At the foot end, pull up on the collar and push the locking handle down 45° and release.

   At the head end, pull up on the collar and push the locking handle down 90° and release.

9. Move the grid cabinet to the head end of the table. Insert the locking pin in the hole marked "Shipping Position".

10. Reinstall the table top, securing it with the three screws removed previously.

11. Carefully place the sub-top (barium shield) on the table top and secure with the table accessories (the shoulder rest, the foot support, and the hand grips).

    The sub-top is fragile. Do NOT stow anything else on top of the sub-top.

5.10 TUBESTAND PREPARATION

Reference **FIGURE 4-1.**

1. Secure the high voltage cables to the column in the fixtures provided.

2. Secure tube arm rotation with the velcro strips provided.

3. Move the tube stand column to the foot end of the rail.

Rotate it so that the controls are pointing toward the head end on the table.

Turn the handle of the spring loaded pin located on the column base, and lock it in position.

Turn the black handle of the tower clamp on the column base to engage the steel block to prevent column rotation.

4. Align the hole of the bracket at the column top with that in the ceiling bracket.

Insert the spring loaded pin to secure.

5. Raise the tube arm on the column to it full height.

Lock into position with the spring loaded pin.

6. Remove the bolt from the hole marked "Operational Position" in the tube arm end and tighten in the hole marked "Shipping Position".

5.11 STOWAGE

Stow containers in position as shown in **FIGURE 5-2.** Secure the containers and equipment with the straps provided.

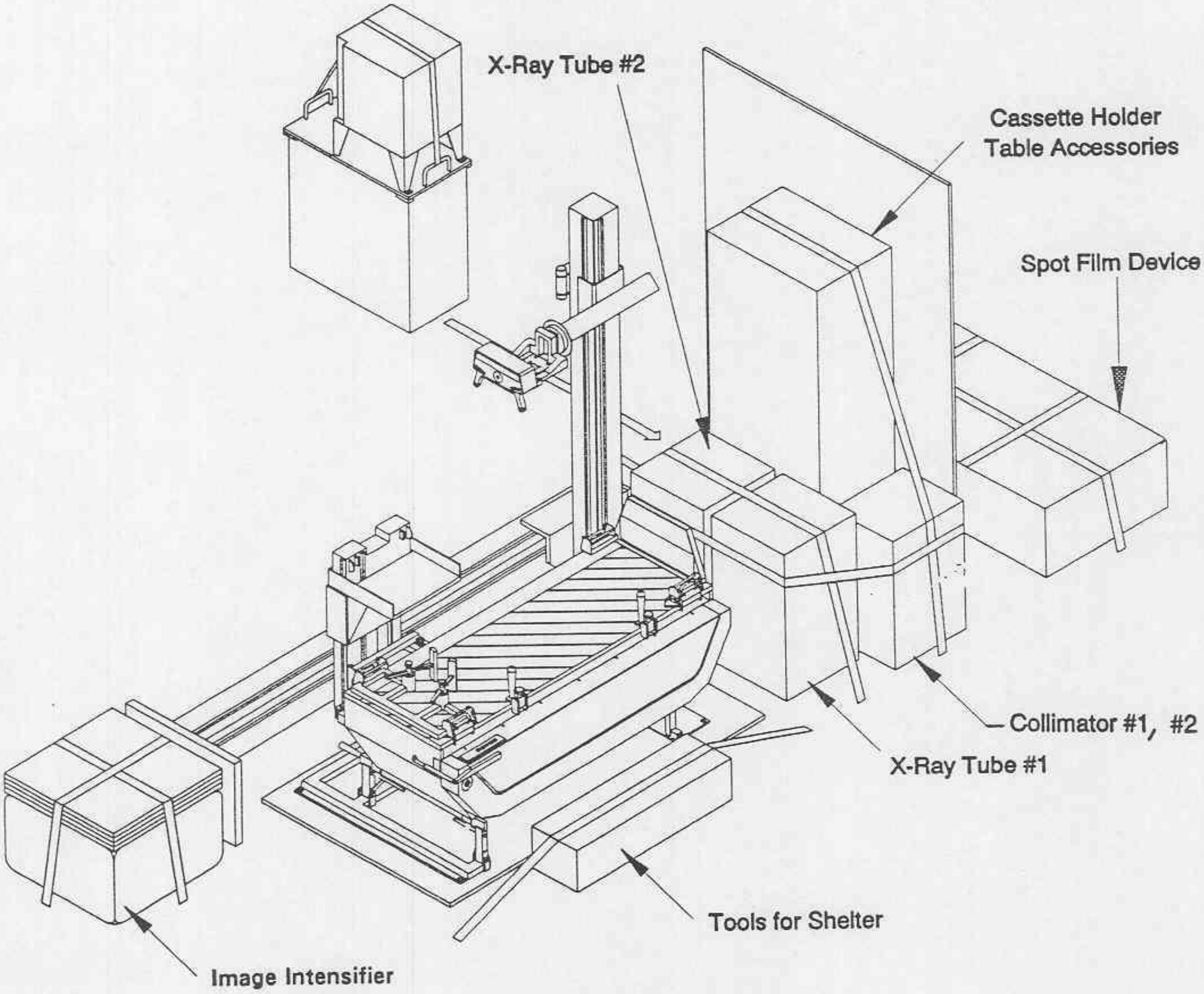

X-Ray Tube #2
Cassette Holder
Table Accessories
Spot Film Device
Collimator #1, #2
X-Ray Tube #1
Tools for Shelter
Image Intensifier

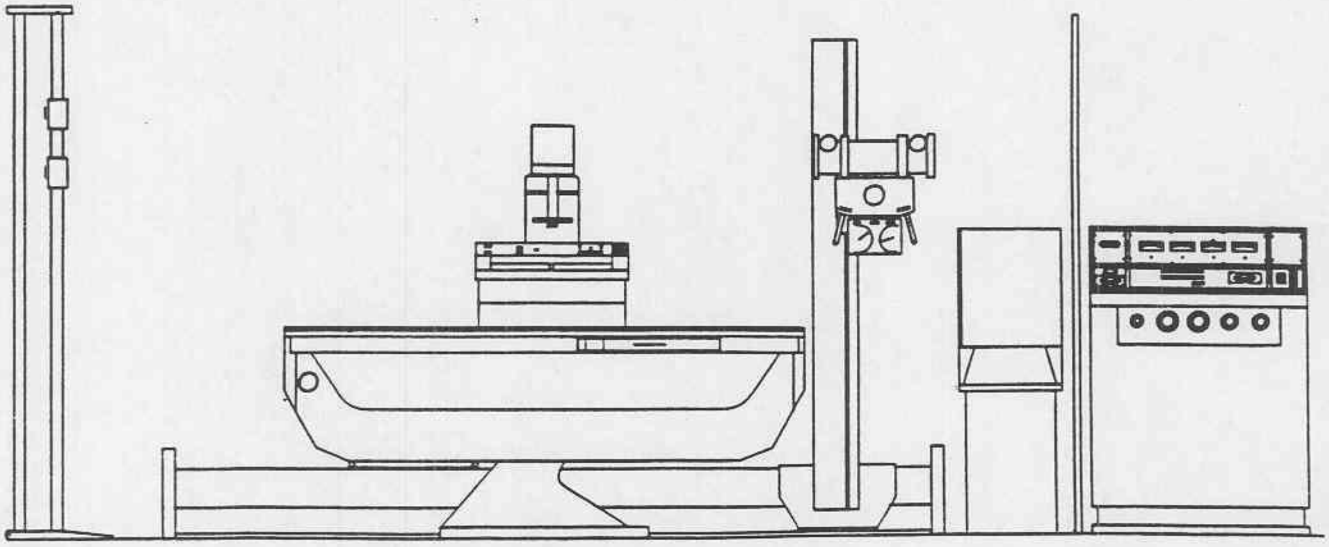
FIGURE 5-2 CONTAINER SHIPPING POSITIONS

THE CONTENTS OF THESE PAGES BELONG IN CHAPTER 3

Updated April 1992
R.G. Bennett

CHAPTER 3

CALIBRATION



CHAPTER 3 - CALIBRATION

TABLE OF CONTENTS

SECTION PAGE

SECTION 1 - GENERAL

1.1 SCOPE 1-1
1.2 TOOLS AND MATERIAL REQUIRED 1-1
1.3 TEST EQUIPMENT REQUIRED 1-2
1.4 PRE-CALIBRATION CHECKS 1-3

SECTION 2 - GENERATOR CALIBRATION

2.1 INTRODUCTION 2-1
2.1.1 50/60 Hz CONVERSION 2-5
2.1.2 X-RAY TUBE WARM UP PROCEDURE 2-8
2.1.3 LINE COMPENSATION 2-8
2.1.4 DETERMINATION OF LINE DROP 2-10
2.1.5 TUBE ROTOR BOOST TIME ADJUSTMENT 2-12
2.1.5.1 OVER-TABLE TUBE ROTOR BOOST TIME ADJUSTMENT 2-12
2.1.5.2 UNDER-TABLE TUBE ROTOR BOOST TIME ADJUSTMENT 2-15
2.1.6 ADJUST RADIOGRAPHIC kVp AND mA METERS 2-16
2.1.7 mA OVERLOAD ADJUSTMENT 2-17
2.1.8 END OF EXPOSURE SIGNAL 2-20
2.1.9 TUBE OVERLOAD ADJUSTMENTS (TOLA) 2-20
2.1.10 RADIOGRAPHIC TIMER (50 Hz and 60 Hz) VERIFICATION 2-24
2.1.11 60 Hz RADIOGRAPHIC TIMER CALIBRATION 2-26
2.1.12 50 Hz RADIOGRAPHIC TIMER CALIBRATION 2-28
2.1.13 60 Hz BACK-UP TIMER CALIBRATION 2-30
2.1.14 50 Hz BACK UP TIMER CALIBRATION 2-33
2.2 GENERATOR CALIBRATION USING NON-INVASIVE METERS 2-36
2.2.1 INSTALLATION OF NON-INVASIVE METERS 2-36
2.2.2 OVER-TABLE FILAMENT CONTROL CALIBRATION 2-37
2.2.3 SPACE CHARGE ZERO ADJUST 2-37
2.2.4 EXPOSURE mAs CALIBRATION 2-37
2.2.5 FILAMENT BOOST ADJUSTMENT 2-39
2.2.6 OVER-TABLE FILAMENT CALIBRATION 2-41
2.2.7 kVp OFFSET & SPACE CHARGE COMPENSATION 2-45
2.2.8 kVp SLOPE & SPACE CHARGE CALIBRATION 2-45
2.2.9 UNDER-TABLE TUBE CALIBRATION 2-48
2.2.10 FLUOROSCOPIC kVp CALIBRATION 2-48
2.2.11 FLUOROSCOPIC mA CALIBRATION 2-50
2.3 CALIBRATION OF THE X-RAY GENERATOR USING A DYNALYZER™ . 2-52

TABLE OF CONTENTS (continued)

SECTION PAGE

2.3.1 INSTALLATION OF THE DYNALYZER™ 2-52
2.3.2 EXPOSURE mAs CALIBRATION 2-53
2.3.3 KVP COMPENSATION 2-54
2.3.4 mA FILAMENT (OVER-TABLE X-RAY TUBE) 2-59
2.3.5 SPACE CHARGE COMPENSATION 2-61
2.3.6 UNDER-TABLE TUBE FILAMENT CALIBRATION 2-64
2.3.7 SPACE CHARGE COMPENSATION (UNDER-TABLE X-RAY TUBE) 2-64
2.3.8 SPOT FILM PREHEAT 2-65
2.3.9 FLUOROSCOPIC KVP CALIBRATION 2-66
2.3.10 FLUOROSCOPIC mA CALIBRATION 2-66
2.4 FIELD EXPEDIENT kVp CALIBRATION USING DIGITAL VOLTMETER . . 2-69

SECTION 3 - SPOT FILM DEVICE CALIBRATION

3.1 SFD CALIBRATION 3-1

SECTION 4 CALIBRATION FOR THE UNDER-TABLE COLLIMATOR

4.1 VOLTAGE CHECKS 4-1
4.2 CENTERING COLLIMATOR USING FLUOROSCOPY 4-1
4.3 CONTINUOUS SID ADJUSTMENT 4-4
4.4 SHUTTER OFFSET ADJUSTMENT 4-5
4.5 SHUTTER GAIN ADJUSTMENT 4-7
4.6 FLUOROSCOPIC IMAGE SIZE ADJUSTMENT 4-11
4.7 1-ON-1 (FULL) RADIOGRAPHIC FILM ADJUSTMENT 4-12
4.8 4-ON-1 RADIOGRAPHIC FILM ADJUSTMENT 4-12
4.9 6-ON-1 RADIOGRAPHIC FILM ADJUSTMENT 4-13
4.10 9-ON-1 RADIOGRAPHIC FILM ADJUSTMENT 4-14
4.11 SID TRACKING VERIFICATION 4-14

SECTION 5 - OVER-TABLE COLLIMATOR CALIBRATION

5.1 GENERAL 5-1
5.2 TEST SWITCH CHECK 5-1
5.2.1 COLLIMATOR TILT SWITCH CHECK 5-1
5.2.2 TABLE TILT SWITCH CHECK 5-3
5.2.3 LOGIC AND COLLIMATOR CHECK USING INTERNAL SIGNALS 5-5
5.2.4 EXTERNAL SID SIGNAL CHECK (HORIZONTAL) 5-6

TABLE OF CONTENTS (continued)

SECTION **PAGE**

5.2.5 TABLE RECEPTOR SID SIGNAL CHECK 5-8
5.2.6 EXTERNAL IR SIGNALS CHECK 5-8
5.2.7 FINAL TEST SWITCH SETTINGS 5-10
5.3 ADJUSTMENT PROCEDURES 5-10
5.3.1 VCPL (R25) AND VCPC (R26) VERIFICATION 5-11
5.3.2 LIGHT FIELD/X-RAY CONGRUENCE TEST 5-12
5.3.3 40" SID ADJUSTMENT 5-15
5.3.4 COLLIMATOR FEEDBACK LINEARITY TEST 5-16
5.3.5 CASSETTE TRAY ADJUSTMENT 5-17
5.3.6 CROSS-HAIR WINDOW ADJUSTMENT 5-18
5.3.7 BUCKY CENTERING LIGHT-LINE ADJUSTMENT 5-18

SECTION 6 - AUTOMATIC EXPOSURE CONTROL (AEC) CALIBRATION

6.1 CALIBRATION INSTRUCTIONS 6-1
6.1.1 CALIBRATION/TEST SET UP 6-1
6.2 kVp LEVEL ADJUSTMENT 6-4
6.3 FIELD MATCHING 6-6
6.4 INPUT AMPLIFIER GAIN ADJUSTMENT 6-8
6.5 kVp COMPENSATION 6-9
6.6 SPOT FILM ION CHAMBER 6-11
6.7 CONCLUSION OF FIELD CALIBRATION 6-12

SECTION 7 - IMAGE INTENSIFIER CALIBRATION

7.1 IMAGE TUBE FOCUS 7-1

FIGURES

FIGURE PAGE

2-1 MXR-350 MAIN CONTROL, PART 1 2-2
2-2 MXR-350 MAIN CONTROL, PART 2 2-3
2-3 OPERATOR MAIN CONTROL PANEL 2-4
2-4 50 or 60 Hz TIMER SELECT DECK 2-6
2-5 POWER CIRCUIT 2-9
2-6 mA/kVp/LINE METER SHUNT PCB 2-11
2-7 ROTOR CONTROL PCB 2-14
2-8 SAMPLE WAVEFORM FOR 2.1.5.1 STEP 2 2-14
2-9 EXPOSURE INTERLOCK PCB 2-18
2-10 EXPOSURE END BUZZER 2-21
2-11 UNIVERSAL TOLA PCB 2-22
2-12 BACK-UP TIMER PCB 2-25
2-13 SAMPLE WAVEFORM FOR 2.1.11 & 2.1.12 STEP 2 2-26
2-14 SINGLE PHASE IMPULSE TIMER 2-27
2-15 SAMPLE WAVEFORM FOR 2.11 STEP 5 2-28
2-16 SAMPLE WAVEFORM 2-29
2-17 SCR IMPULSE TIMER PCB 2-31
2-18 SAMPLE WAVEFORMS FOR 2.1.13 and 2.1.14, STEP 6 2-32
2-19 SAMPLE WAVEFORMS FOR 2.1.13 and 2.1.14, STEP 9 2-34
2-20 CONSTANT CURRENT FILAMENT CONTROL PCB 2-38
2-21 mAs CURRENT INTEGRATOR PCB 2-40
2-22 FILAMENT BOOST WAVEFORM 2-42
2-23 kVp COMPENSATION PCB 2-47
2-24 FLUORO mA CONTROL PCB 2-68

4-1 UNDER-TABLE LOGIC PCB 4-2
4-2 COLLIMATOR BLADE CONFIGURATION 4-3
4-3 Z80 INTERFACE PCB 4-9

5-1 OVER-TABLE COLLIMATOR 5-2
5-2 LOGIC PCB 5-4
5-3 TEST PATTERN 5-7
5-4 LIGHT FIELD VS. X-RAY FIELD CONGRUENCY 5-12
5-5 COLLIMATOR LAMP SECTION 5-14
5-6 CASSETTE TRAY POTENTIOMETER WIRING 5-17

6-1 ADJUSTMENT COMPONENT LOCATION 6-5
6-2 PREAMPLIFIER ADJUSTMENT COMPONENT LOCATIONS 6-7

TABLES

TABLE PAGE

2-1 TOLA ADJUSTMENTS 2-23
2-2 FILAMENT BOOST ADJUSTMENT 2-41
2-3 FILAMENT CALIBRATION WORKSHEET 2-43
2-4 FILAMENT ADJUSTMENT POTS 2-44
2-5 kVp OFFSET & SPACE CHARGE WORKSHEET 2-46
2-6 kVp SLOPE & SPACE CHARGE WORKSHEET 2-49
2-7 200L SPOT CALIBRATION WORKSHEET 2-51
2-8 kVp COMPENSATION 2-57

6-1 PCB DRAWING REFERENCE 6-3
6-2 kVp COMPENSATION SETTINGS 6-10

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CHAPTER THREE - CALIBRATION

SECTION 1 - GENERAL

1.1. SCOPE

This chapter describes the calibration of the **CS-8952 FIELD DEPLOYABLE X-RAY SYSTEM**. These instructions apply equally to **ALL** installation configurations unless otherwise specified.

Calibration of the x-ray generator, described in Section 2 of this chapter, can be performed with either a complete set of "non-invasive" x-ray calibration meters, or a Dynalyzer™ (kVp measuring tank). Both instructions are included, and the instructions designated for the type of test equipment used must be followed.

1.2. TOOLS AND MATERIAL REQUIRED

NOTE:
Also, see Section 1.3 for **test equipment** required.

- slot tip screwdrivers
- #1 and #2 phillips screwdrivers
- 1/2" cam adjusting open end wrench (Continental part #4144.234.01, supplied, see Section 2.1.1)
- needle-nosed pliers
- set of hex key ("allen") wrenches
- grease pencil or masking tape
- cleaner for high voltage cable contacts
- x-ray film, 9-1/2" x 9-1/2", 8" x 10", and 10" x 12"
- x-ray film cassettes for above film sizes
- beam attenuator
- 4 radiopaque markers, 1.5" X 0.5" X 1/32" (38mm X 13mm X .8mm)
- jumper wire
- 0.2 mm spaced metallic (stainless steel or copper) wire mesh .2 mm diameter
- measuring tape
- insulating compound, such as Dow DC-4

1.3. TEST EQUIPMENT REQUIRED

> **NOTE:**
> Also, see Section 1.2 for **tools and material** required.

For non-invasive calibration, the following equipment is required:

kVp meter	(Nuclear Associates model 07-494, or equivalent)
mAs meter	(Nuclear Associates model 07-472, or equivalent)
x-ray calibration timer	(Nuclear Associates model 07-457, or equivalent)

OR:

For invasive calibration, the following equipment is required:

Dynalyzer™ (or kVp measuring tank)

Either of the above methods also require the following:

- digital multimeter, 500 Volts DC, 500 Volts AC, 1000 mA DC, ±1%
- dual channel oscilloscope (scope), calibrated DC to minimum 100 kHz, 0.1 Volts DC/cm with long persistence phosphor or storage capability
- DC current source with milliammeter, with at least 360 mA capacity
- radiation dose rate meter, 0 to 10 R/minute (Victoreen model 06-526 or equivalent)
- densitometer, or 1.0 neutral density filter, for density comparison
- patient phantom, or water phantom (a clean, flat-bottomed, plastic bucket with a minimum diameter of 6" which can be filled with up to 12" of tap water)
- x-ray film processor
- dark room

1.4 PRE-CALIBRATION CHECKS

NOTE:

Do **NOT** install the sub-top (barium shield) or the table top until calibration is completed. Several steps in the calibration procedure require adjustments inside the table that cannot be accessed with the sub-top in place.

The equipment may be shipped and/or installed without the sub-top of the table attached. Instructions for table top removal are in Chapter 2, Installation.

Before calibration is performed, make a general inspection of the equipment and its functions as follows:

1. Check that all mechanical movements are free moving, and do not rub or block cabling.
2. Inspect the system for protruding screws, potential cable strains, etc.
3. With **[MAINS]** on, verify that all magnetic locks hold securely.
4. Tilt the table as far as it will tilt in both directions. Verify that it does not come in contact with the floor or the ceiling.
5. Move the tubestand to each end of its rail, and vertical to its limits.
6. Rotate the over-table tube in all directions.

If mechanical parts need adjustment, see Chapter 2, Installation, for instructions.

NOTES

SECTION 2 - GENERATOR CALIBRATION

WARNING

HIGH VOLTAGE PRESENT.

Observe all safety precautions and practices.

2.1 INTRODUCTION

The **MXR-350 X-ray Generator** is completely calibrated and aligned before it leaves the factory, ensuring that the generator operates according to specifications and complies with CDRH regulations.

Because factory adjustments are frequently disturbed during transportation or installation, and operating conditions, such as incoming power characteristics, will vary from one location to another, calibration must be performed whenever the system is moved or reinstalled.

In addition, calibration must be maintained throughout the life of the generator because x-ray tube characteristics change during normal usage, and with tube aging. This is necessary to ensure the safety of patients and operators.

These calibration procedures assume the entire system is installed and operational.

WARNING

Generator calibration requires the production of x-rays and mandates the STRICT observance of ALL safety precautions, including the use of protective devices.

Calibration of the x-ray generator requires either a complete set of "non-invasive" x-ray calibration meters, or a Dynalyzer™ (kVp measuring tank). The instructions are different depending on the type of test equipment used for calibration. For both types of test equipment, follow all of the instructions in **Section 2.1**. Then, follow **Section 2.2** when calibrating with non-invasive meters, or **Section 2.3** when using a Dynalyzer™ for calibration.

FIGURES 2-1 and **2-2** show the MXR-350 Main Control. **FIGURE 2-3** shows the Operator Main Control Panel.

SEE ADJACENT FOLDOUT FOR THIS PAGE.

FIGURE 2-1 MXR-350 MAIN CONTROL, PART 1

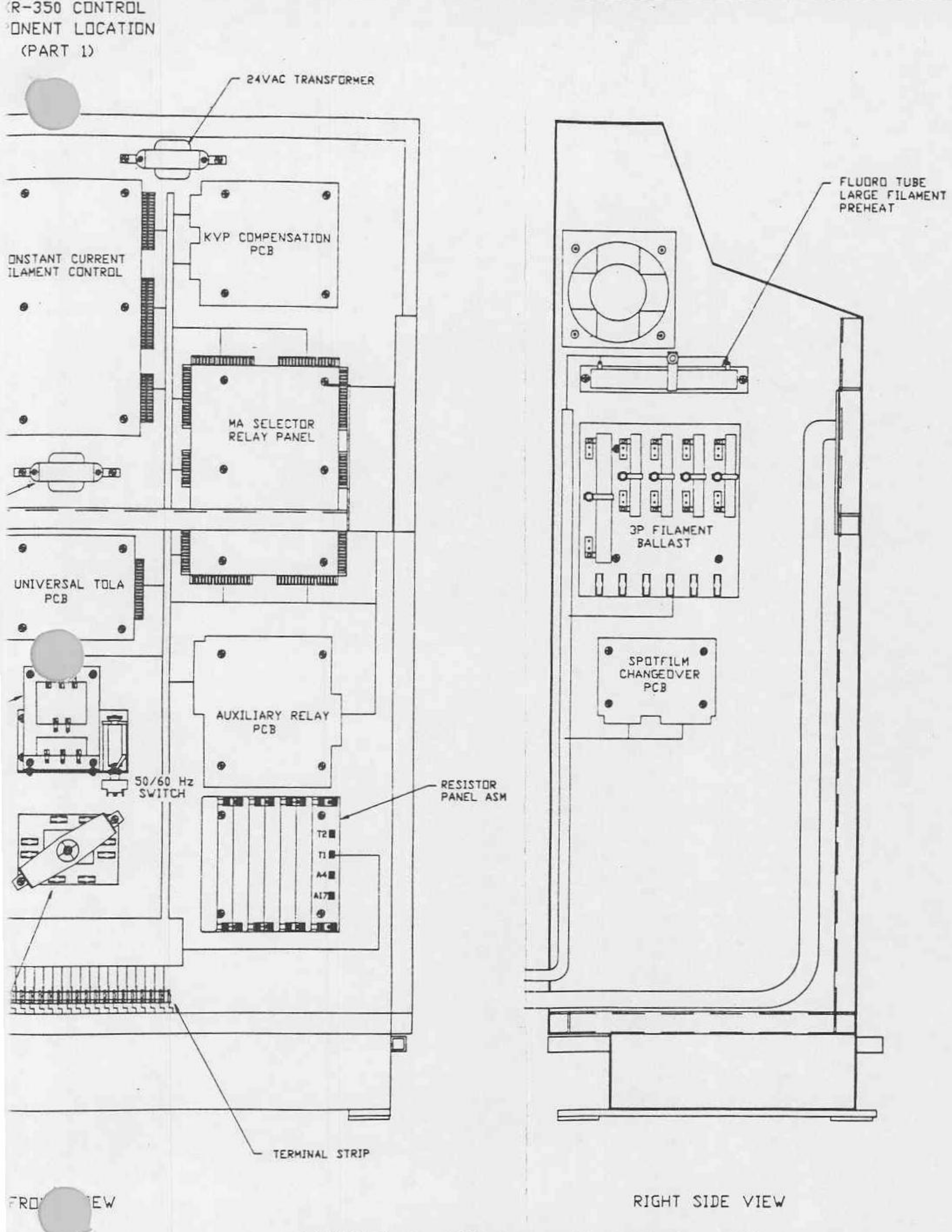
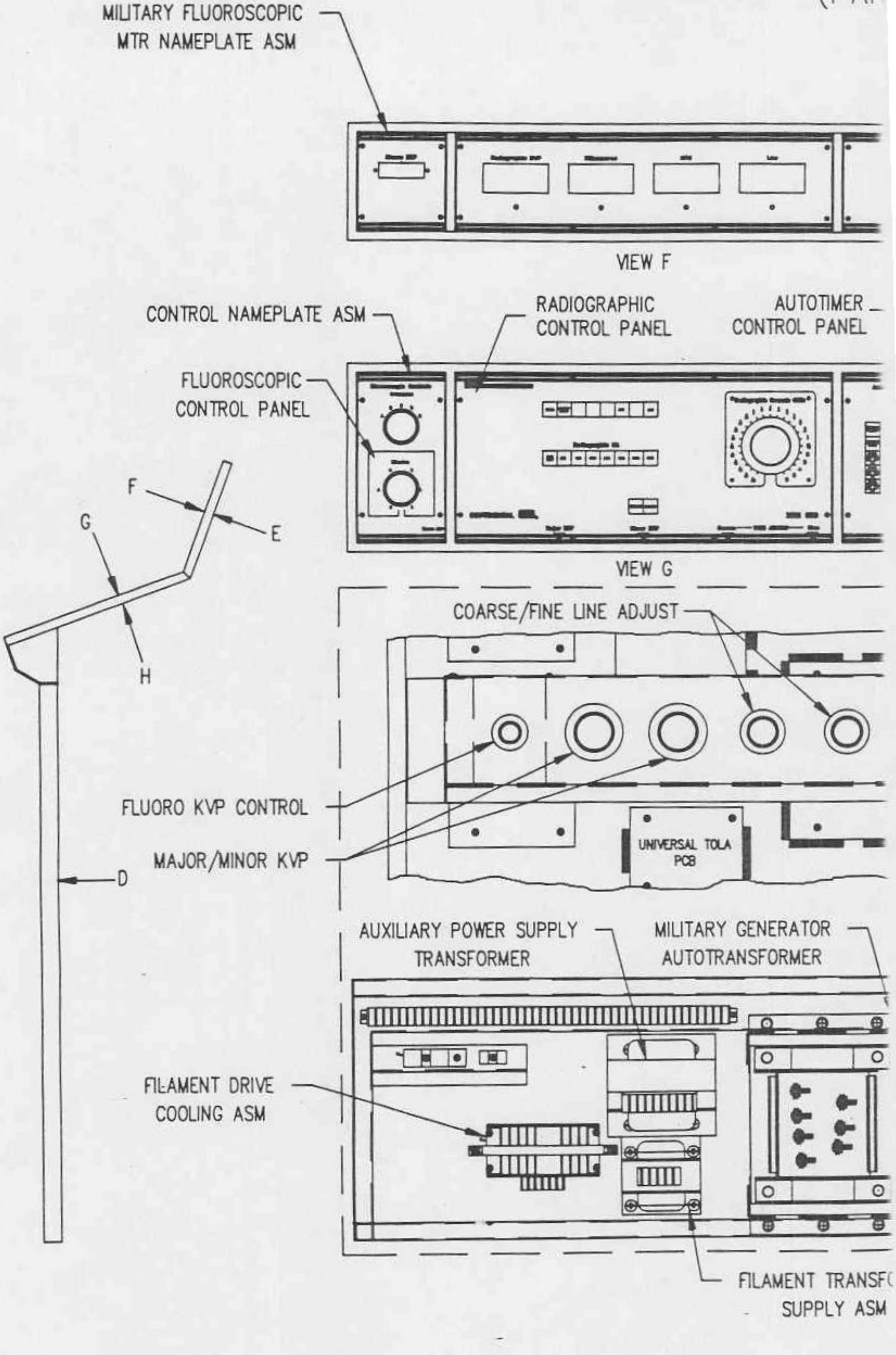
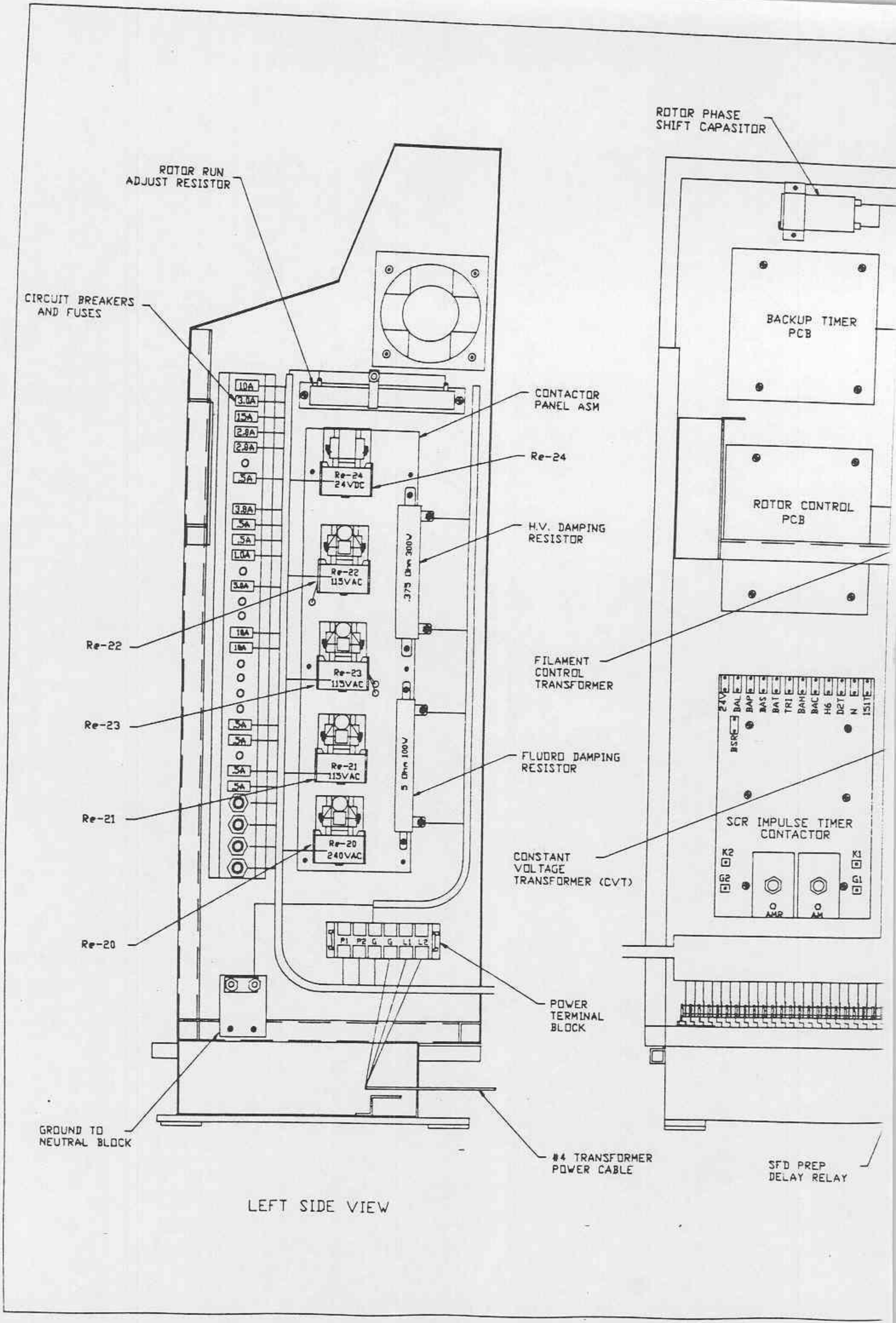

R-350 CONTROL
ONENT LOCATION
(PART 1)
24VAC TRANSFORMER
KVP COMPENSATION PCB
ONSTANT CURRENT
ILAMENT CONTROL
MA SELECTOR RELAY PANEL
UNIVERSAL TOLA PCB
AUXILIARY RELAY PCB
50/60 Hz SWITCH
RESISTOR PANEL ASM
T2
T1
A4
A17
TERMINAL STRIP
FRO EW
FLUORO TUBE LARGE FILAMENT PREHEAT
3P FILAMENT BALLAST
SPOTFILM CHANGEOVER PCB
RIGHT SIDE VIEW

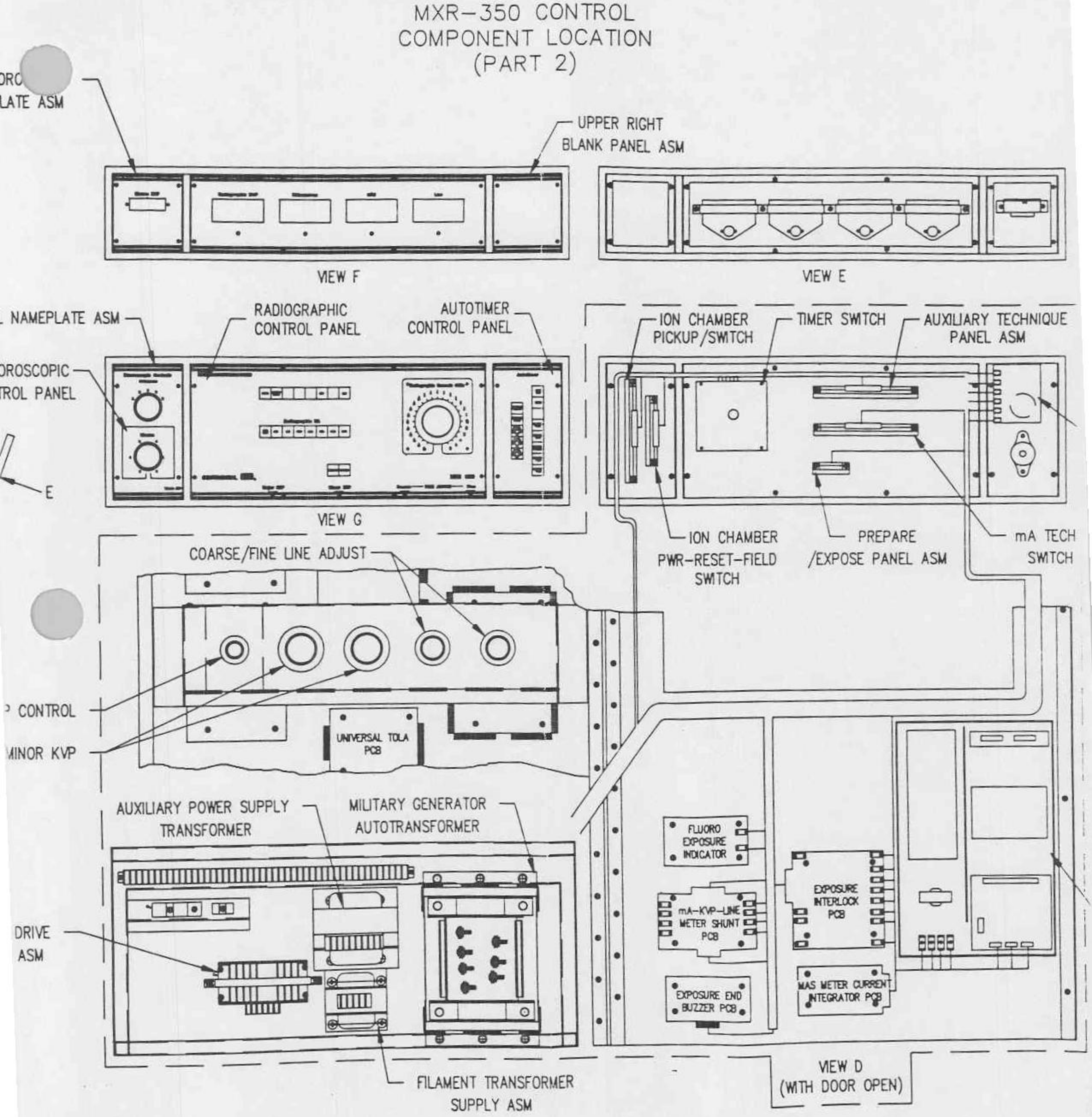
FIGURE 2-1 MXR-350 MAIN CONTROL, PART 1

MXR−350
COMPONEN
(PAF


MILITARY FLUOROSCOPIC MTR NAMEPLATE ASM
VIEW F
CONTROL NAMEPLATE ASM
RADIOGRAPHIC CONTROL PANEL
AUTOTIMER CONTROL PANEL
FLUOROSCOPIC CONTROL PANEL
F
E
G
H
D
VIEW G
COARSE/FINE LINE ADJUST
FLUORO KVP CONTROL
MAJOR/MINOR KVP
UNIVERSAL TOLA PCB
AUXILIARY POWER SUPPLY TRANSFORMER
MILITARY GENERATOR AUTOTRANSFORMER
FILAMENT DRIVE COOLING ASM
FILAMENT TRANSF
SUPPLY ASM


ROTOR PHASE SHIFT CAPASITOR
ROTOR RUN ADJUST RESISTOR
CIRCUIT BREAKERS AND FUSES
BACKUP TIMER PCB
10A
3.0A
15A
2.8A
2.8A
.5A
3.8A
.5A
.5A
1.0A
3.8A
10A
10A
.5A
.5A
.5A
.5A
CONTACTOR PANEL ASM
Re-24
Re-24 24VDC
ROTOR CONTROL PCB
H.V. DAMPING RESISTOR
.375 Ohm 300V
Re-22 115VAC
Re-22
FILAMENT CONTROL TRANSFORMER
Re-23 115VAC
Re-23
24V
BAL
BAP
BAS
BAT
TRI
BAH
BAC
H6
D2T
N
151T
BSRE
FLUORO DAMPING RESISTOR
5 Ohm 100V
Re-21 115VAC
Re-21
SCR IMPULSE TIMER CONTACTOR
K2
G2
K1
G1
AMR
AM
CONSTANT VOLTAGE TRANSFORMER (CVT)
Re-20 240VAC
Re-20
P1
P2
G
G
L1
L2
POWER TERMINAL BLOCK
GROUND TO NEUTRAL BLOCK
#4 TRANSFORMER POWER CABLE
SFD PREP DELAY RELAY

LEFT SIDE VIEW


MXR–350 CONTROL
COMPONENT LOCATION
(PART 2)
ORO
LATE ASM
UPPER RIGHT
BLANK PANEL ASM
VIEW F
VIEW E
L NAMEPLATE ASM
RADIOGRAPHIC
CONTROL PANEL
AUTOTIMER
CONTROL PANEL
ION CHAMBER
PICKUP/SWITCH
TIMER SWITCH
AUXILIARY TECHNIQUE
PANEL ASM
OROSCOPIC
TROL PANEL
E
VIEW G
ION CHAMBER
PWR–RESET–FIELD
SWITCH
PREPARE
/EXPOSE PANEL ASM
mA TECH
SWITCH
COARSE/FINE LINE ADJUST
P CONTROL
MINOR KVP
UNIVERSAL TOLA
PCB
AUXILIARY POWER SUPPLY
TRANSFORMER
MILITARY GENERATOR
AUTOTRANSFORMER
FLUORO
EXPOSURE
INDICATOR
DRIVE
ASM
mA–KVP–LINE
METER SHUNT
PCB
EXPOSURE
INTERLOCK
PCB
EXPOSURE END
BUZZER PCB
MAS METER CURRENT
INTEGRATOR PCB
FILAMENT TRANSFORMER
SUPPLY ASM
VIEW D
(WITH DOOR OPEN)

9086 FIGURE 2-2 MXR-350 MAIN CONTROL, PART 2

NTROL
DO ON
2)

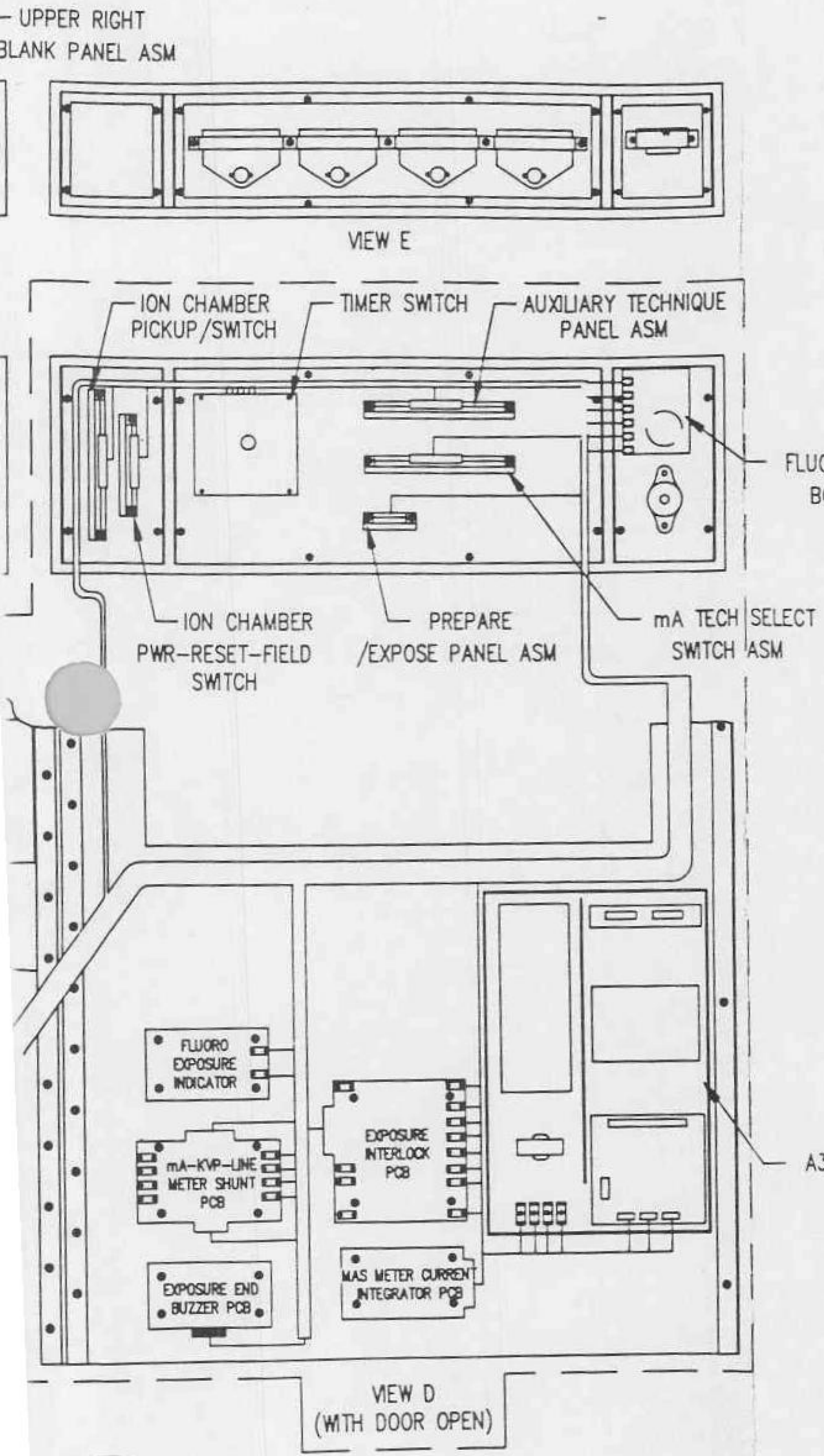

– UPPER RIGHT
BLANK PANEL ASM
VIEW E
ION CHAMBER
PICKUP/SWITCH
TIMER SWITCH
AUXILIARY TECHNIQUE
PANEL ASM
FLUORO mA CONTROL
BOARD ASSEMBLY
ION CHAMBER
PWR–RESET–FIELD
SWITCH
PREPARE
/EXPOSE PANEL ASM
mA TECH SELECT
SWITCH ASM
FLUORO
EXPOSURE
INDICATOR
mA–KVP–LINE
METER SHUNT
PCB
EXPOSURE
INTERLOCK
PCB
A3365–G AEC CONTROL
EXPOSURE END
BUZZER PCB
MAS METER CURRENT
INTEGRATOR PCB
VIEW D
(WITH DOOR OPEN)

FIG 2-2 MXR-350 MAIN CONTROL, PART 2

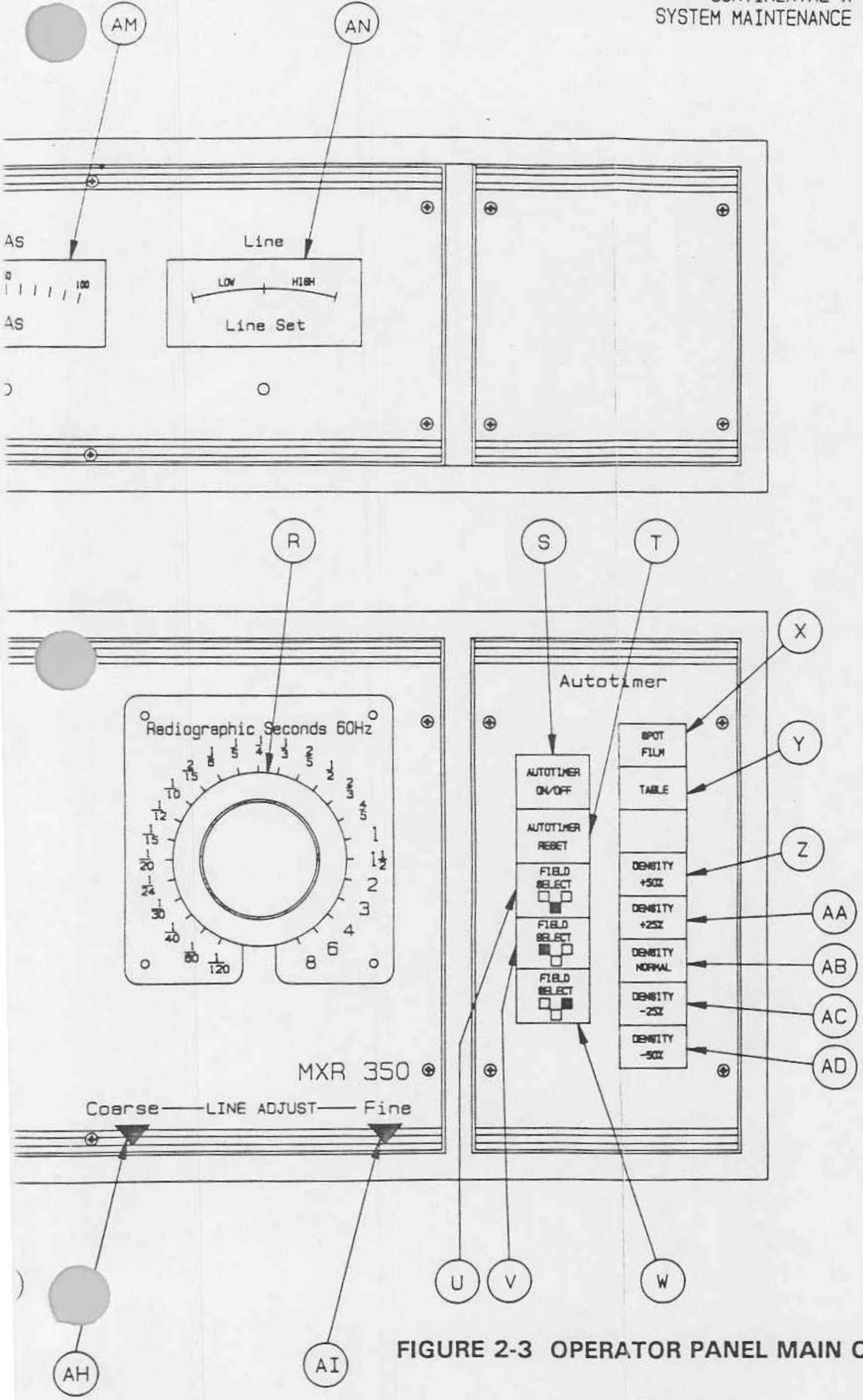
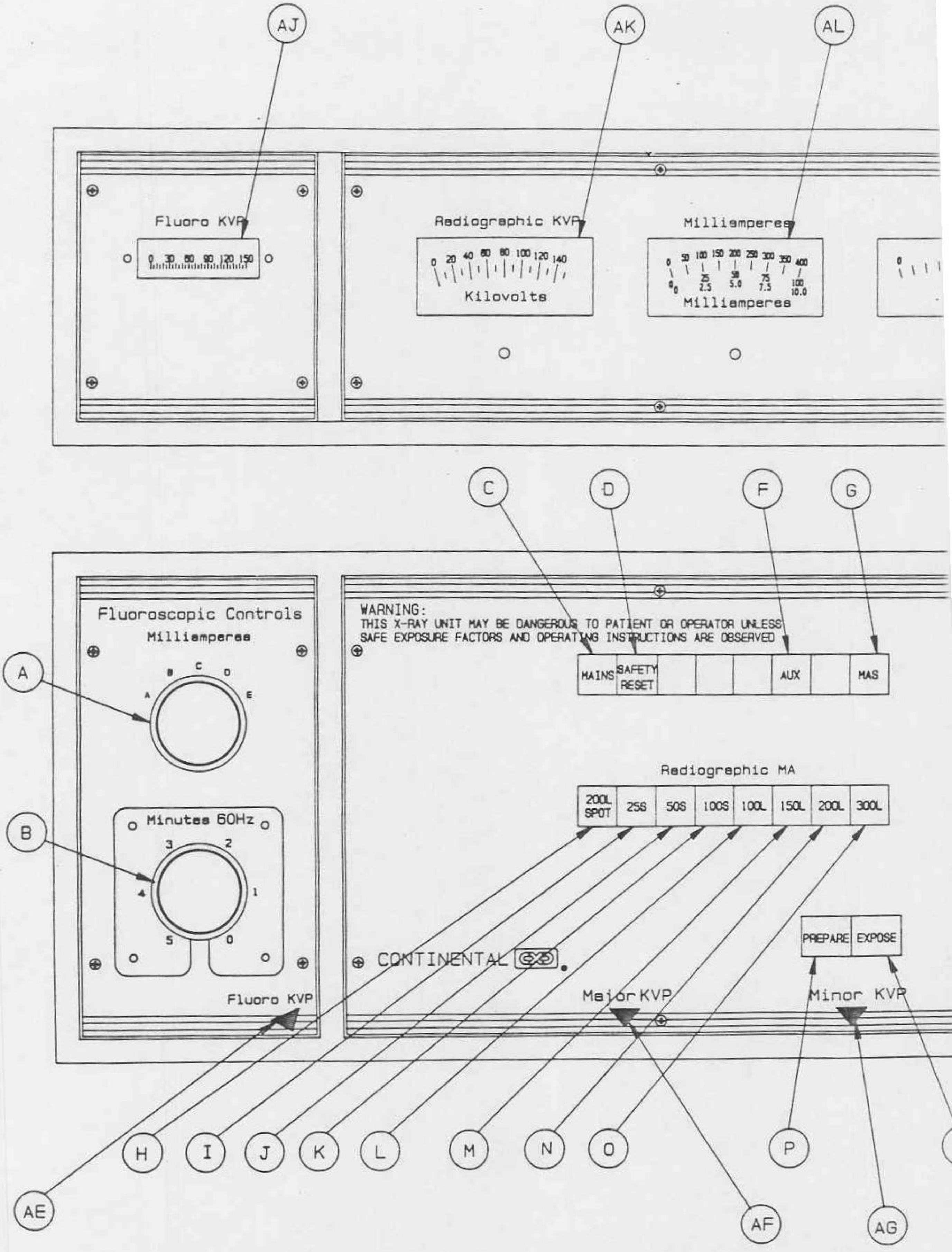

AM
AN
AS
100
AS
Line
LOW
HIGH
Line Set
R
S
T
X
Y
Z
AA
AB
AC
AD
Autotimer
Radiographic Seconds 60Hz
1/120
1/60
1/40
1/30
1/24
1/20
1/15
1/12
1/10
2/15
1/8
1/5
1/4
1/3
2/5
1/2
2/3
4/5
1
1½
2
3
4
6
8
AUTOTIMER ON/OFF
AUTOTIMER RESET
FIELD SELECT
FIELD SELECT
FIELD SELECT
SPOT FILM
TABLE
DENSITY +50%
DENSITY +25%
DENSITY NORMAL
DENSITY -25%
DENSITY -50%
MXR 350
Coarse
LINE ADJUST
Fine
U
V
W
AH
AI

FIGURE 2-3 OPERATOR PANEL MAIN CONTROL


AJ
AK
AL
Fluoro KVP
0 30 60 90 120 150
Radiographic KVP
0 20 40 60 80 100 120 140
Kilovolts
Milliamperes
0 50 100 150 200 250 300 350 400
0 25 50 75 100
0 2.5 5.0 7.5 10.0
Milliamperes
0
C
D
F
G
Fluoroscopic Controls
Milliamperes
A B C D E
WARNING:
THIS X-RAY UNIT MAY BE DANGEROUS TO PATIENT OR OPERATOR UNLESS
SAFE EXPOSURE FACTORS AND OPERATING INSTRUCTIONS ARE OBSERVED
MAINS
SAFETY RESET
AUX
MAS
A
Radiographic MA
200L SPOT
25S
50S
100S
100L
150L
200L
300L
B
Minutes 60Hz
3 2 4 1 5 0
PREPARE
EXPOSE
CONTINENTAL
Fluoro KVP
Major KVP
Minor KVP
H
I
J
K
L
M
N
O
P
AE
AF
AG

9175

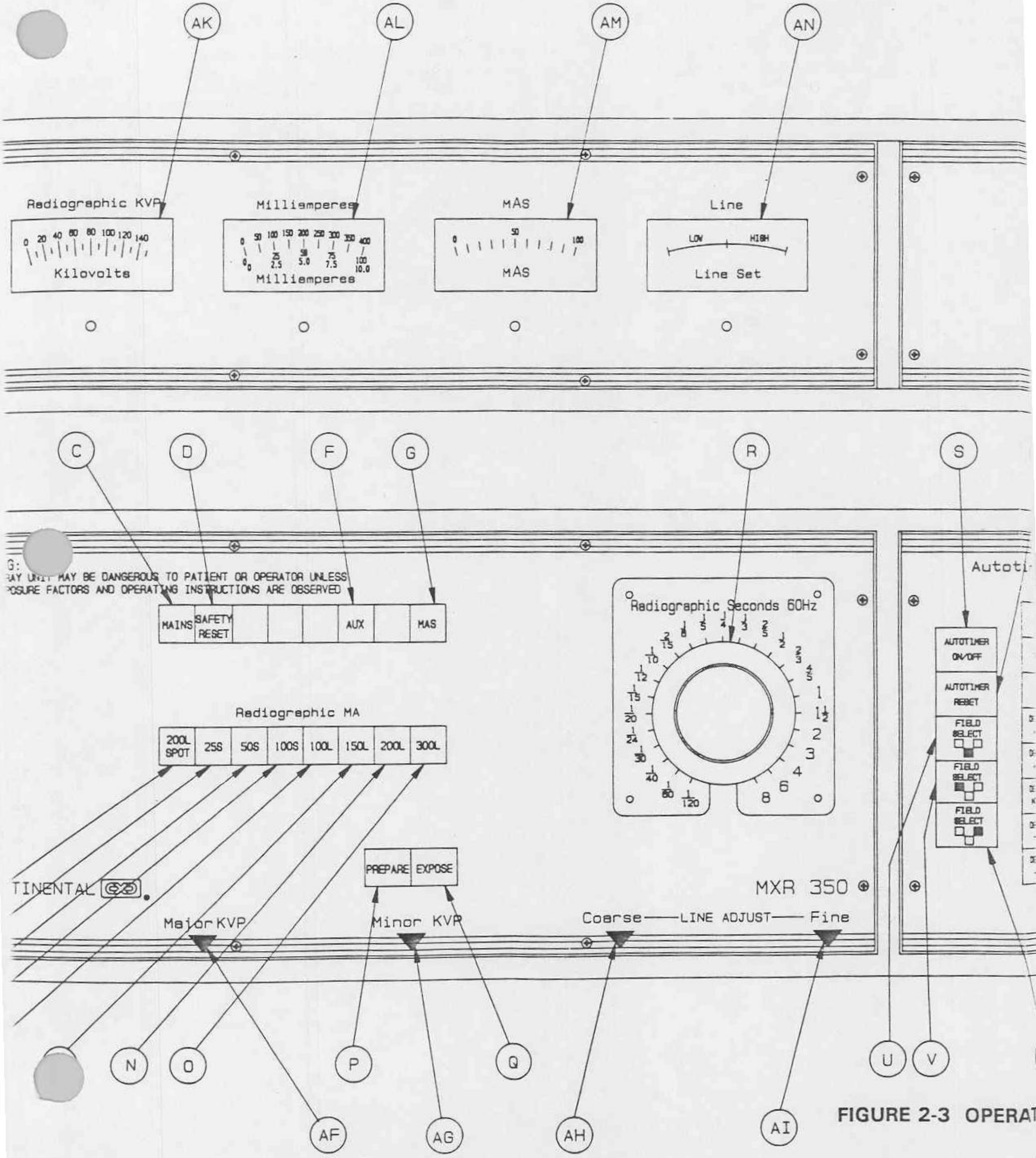

AK
AL
AM
AN
Radiographic KVP
0 20 40 60 80 100 120 140
Kilovolts
Milliamperes
0 50 100 150 200 250 300 350 400
0 25 50 75 100
0 2.5 5.0 7.5 10.0
Milliamperes
MAS
0 50 100
MAS
Line
LOW HIGH
Line Set
C
D
F
G
R
S
G:
RAY UNIT MAY BE DANGEROUS TO PATIENT OR OPERATOR UNLESS
POSURE FACTORS AND OPERATING INSTRUCTIONS ARE OBSERVED
MAINS
SAFETY RESET
AUX
MAS
Radiographic MA
200L SPOT
25S
50S
100S
100L
150L
200L
300L
Radiographic Seconds 60Hz
1/120 1/60 1/40 1/30 1/24 1/20 1/15 1/12 1/10 2/15 1/6 1/5 1/4 1/3 2/5 1/2 2/3 4/5 1 1½ 2 3 4 6 8
Autoti
AUTOTIMER ON/OFF
AUTOTIMER RESET
FIELD SELECT
FIELD SELECT
FIELD SELECT
TINENTAL
PREPARE
EXPOSE
MXR 350
Major KVP
Minor KVP
Coarse
LINE ADJUST
Fine
N
O
P
Q
U
V
AF
AG
AH
AI

FIGURE 2-3 OPERAT

9175

2.1.1 50/60 Hz CONVERSION

The **MXR-350 X-Ray Generator** can operate from either a 50 Hz or 60 Hz power source. The following procedure will adapt the generator to the power line frequency used. If the generator is not adjusted for the correct frequency, it is necessary to make the following conversion.

NOTE
This unit is shipped from the manufacturer in the 60 Hz configuration.

1. Turn [**MAINS**] off and open the control door.

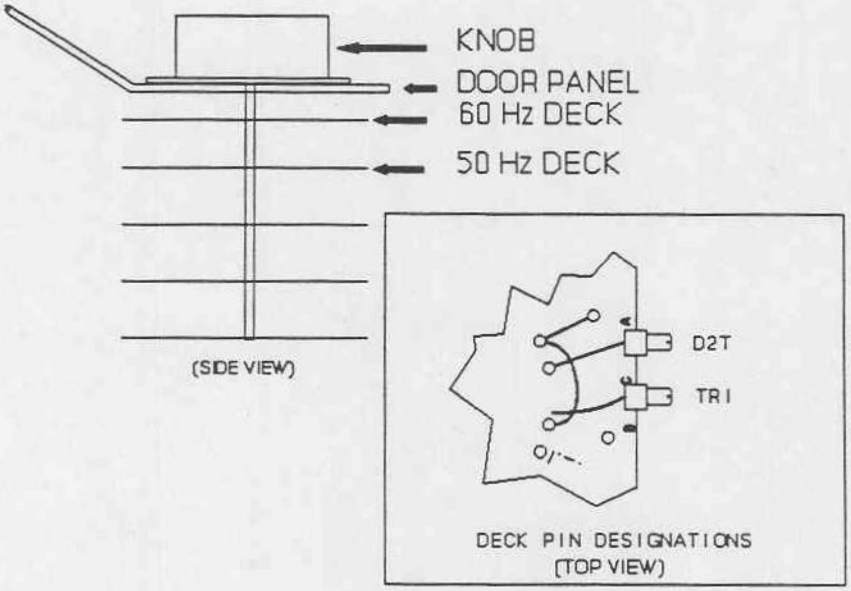
2. Remove the four screws holding the dual-sided Radiographic Seconds select panel (**FIGURE 2-3**, R). Rotate the panel until it can be removed from under the knob (it should not be necessary to remove the knob). Position the desired scale (50 Hz or 60 Hz) of the panel face up. Slide it back under the knob into the correct position. Replace the panel screws.

NOTE
All line frequency dependent components inside the main control cabinet are labeled with a red tag for easy identification.

3. Two time select decks are located inside the control door, behind the Radiographic Seconds panel. Install leads D2T and TRI on appropriate time select deck (50 or 60 Hz), shown in **FIGURE 2-4**.

4. Select the appropriate 50 Hz or 60 Hz position on the Constant Voltage Transformer selector switch (**FIGURE 2-1**, middle view, lower center).

5. Remove the four screws holding the dual-sided Fluoroscopic Controls "Minutes" dial, **FIGURE 2-3**, B. Rotate the panel until it can be removed from under the knob. Position the appropriate 50 Hz or 60 Hz scale face up and slide into the correct position. Replace the panel screws.


KNOB
DOOR PANEL
60 Hz DECK
50 Hz DECK
(SIDE VIEW)
D2T
TRI
DECK PIN DESIGNATIONS
(TOP VIEW)

NOTE: Deck pin designations are the same for both the 60 Hz and the 50 Hz timer decks. Connect the leads to the deck desired.

FIGURE 2-4 50 or 60 Hz TIMER SELECT DECK

2.1.1 50/60 Hz CONVERSION (continued)

6. The internal "Minutes" switch must be depressed at the <0> position. To verify it is correctly positioned, listen carefully while slowly rotating the "Minutes" knob back and forth across the <0> mark. If a "click" can be heard, the "Minutes" switch <0> cam is correctly positioned.

7. If no "click" can be heard, use the following method to reposition:

    - use the wrench attached to the "Minutes" (timer) assembly (Continental part #4144.234.01)

    - point the knob at <0> and hold in place, while turning the black cam with the wrench until the switch activates (makes a "click" with switch arm depressed).

8. Rotate the "Minutes" knob to <5> .

    - hold the knob and rotate the white cam with the wrench (clockwise to increase time; counterclockwise to decrease time, looking from the timer motor side) until the switch releases (makes a "click").

This step allows the Fluoroscopic Controls "Minutes" knob to operate at the "5 Minute" time set position.

NOTE

When converting from 60 Hz to 50 Hz, rotate the white cam counterclockwise (looking from the timer motor side).

For 50 Hz to 60 Hz conversion, rotate the white cam clockwise (looking from the timer motor side).

9. Move the "Minutes" knob to <3> and verify the switch remains depressed.

This completes the 50 or 60 Hz conversion.

2.1.2 X-RAY TUBE WARM UP PROCEDURE ☢

Before calibration, each x-ray tube MUST be warmed up using the following procedure. This will substantially reduce the possibility of damage to the x-ray tube anode caused by "hot spots" and uneven heating.

Follow this procedure on both the under-table and over-table x-tubes. This procedure should also be followed before any service work is performed on a cold tube.

1. Turn **[MAINS]** ON. Close the appropriate collimator blades.
2. Select the **[200L]** mA station, **<70 kVp>**, and **<1/2 second>**, with NO autotiming. Make three exposures at 20 second intervals.
3. Raise to **<80 kVp>**. Make three exposures at 20 second intervals.
4. Raise to **<90 kVp>**. Make three exposures at 20 second intervals.
5. Raise to **<100 kVp>**. Make three exposures at 20 second intervals.

The warm up procedure is complete.

NOTE

Perform the Warm Up Procedure no more than one hour before the first case of the day, or if the system has been idle for eight hours or longer. This will protect the x-ray tube from potentially damaging high exposures on a cold target, due to thermal shock. Thermal shock can cause a target to fracture, and in extreme cases, the target may break apart causing damage to the insert and/or the tube housing. Warming up increases the life of the x-ray tube.

2.1.3 LINE COMPENSATION

While the generator operates from a nominal 240 volt AC line (**FIGURE 2-5** Power Circuit), the input voltage range can be between 190 to 270 volts. Line compensation ensures that the main autotransformer produces the proper outputs for any input voltage within this range. Line compensation calibration adjusts the Line meter so that it accurately indicates the autotransformer voltage.

1. Turn **[MAINS]** off. Connect an AC voltmeter between AC and AM (center taps from the major and minor kVp switches).

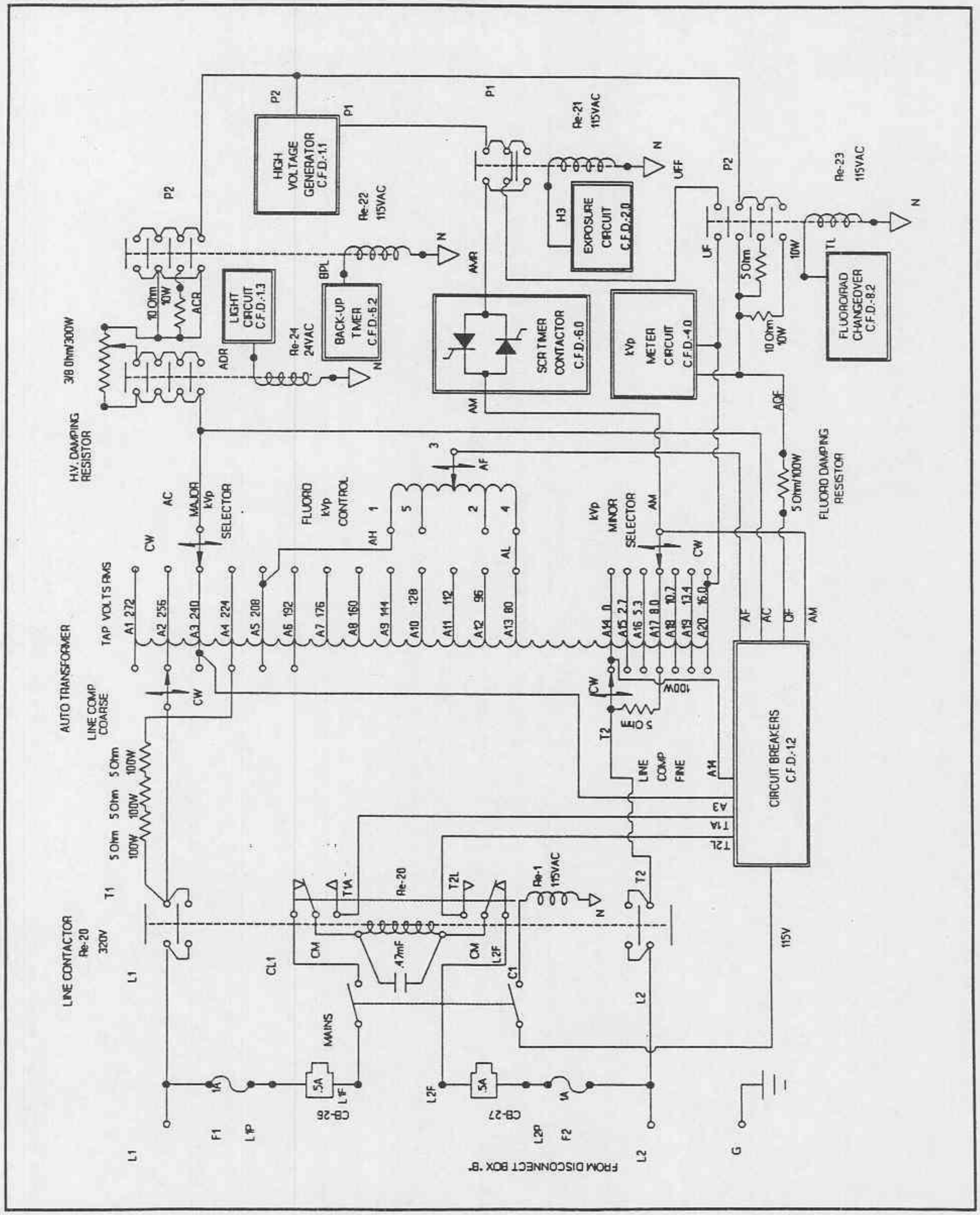

LINE CONTACTOR
Re-20
320V
L1
T1
T2
L2
CL1
CM
.47mF
Re-20
T1A
T2L
L2F
C1
Re-1
115VAC
N
MAINS
CB-26
.5A
L1F
CB-27
5A
L2F
1A
F1
F2
L1P
L2P
FROM DISCONNECT BOX "B"
G
115V
AUTO TRANSFORMER
LINE COMP
COARSE
5 Ohm
100W
CW
TAP VOLTS RMS
A1 272
A2 256
A3 240
A4 224
A5 208
A6 192
A7 176
A8 160
A9 144
A10 128
A11 112
A12 96
A13 80
A14 0
A15 2.7
A16 5.3
A17 8.0
A18 10.7
A19 13.4
A20 16.0
100W
5 Ohm
LINE
COMP
FINE
A14
A3
T1A
T2L
CIRCUIT BREAKERS
C.F.D.-12
AF
AC
QF
AM
H.V. DAMPING
RESISTOR
3/8 Ohm/300W
AC
MAJOR
kVp
SELECTOR
FLUORO
kVp
CONTROL
AH
AL
1
2
3
4
5
kVp
MINOR
SELECTOR
FLUORO DAMPING
RESISTOR
5 Ohm/100W
AQF
ADR
ACR
10 Ohm
10W
P2
LIGHT
CIRCUIT
C.F.D.-1.3
Re-24
24VAC
BACK-UP
TIMER
C.F.D.-5.2
BPL
Re-22
115VAC
HIGH
VOLTAGE
GENERATOR
C.F.D.-1.1
P1
AMR
AM
SCR TIMER
CONTACTOR
C.F.D.-6.0
kVp
METER
CIRCUIT
C.F.D.-4.0
H3
EXPOSURE
CIRCUIT
C.F.D.-2.0
Re-21
115VAC
UFF
UF
Re-23
115VAC
5 Ohm
10 Ohm
10W
TL
FLUORO/RAD
CHANGEOVER
C.F.D.-8.2

FIGURE 2-5 POWER CIRCUIT

2.1.3 LINE COMPENSATION (continued)

2. Turn the Major KVP and Minor KVP controls fully clockwise. Turn [**MAINS**] on. If the voltmeter does not read 288 (± 3) volts AC, adjust the Line Adjust Coarse and Fine controls until it does.

3. Adjust P2 on the mA/kVp/Line Meter Shunt PCB (6284.234.12), **FIGURE 2-6**, to center the needle on the Line meter.

2.1.4 DETERMINATION OF LINE DROP ☢

For accurate calibration, it is necessary to determine the line voltage drop during an exposure. "Line drop" is expressed as a percentage of the "no load" line voltage.

1. Turn [**MAINS**] off. Connect a voltmeter between L1 and L2 on the terminal strip inside the main control (**FIGURE 2-1**). Select an AC scale on the voltmeter that includes the incoming line voltage.

2. Turn [**MAINS**] on. Be sure that line compensation has been correctly set as described in **Section 2.1.3** preceding.

3. Measure the incoming line voltage; record below as "Vnl" (voltage with "no load").

4. Make an exposure with the over-table tube at [**300L**] mA, <**75 kVp**>, for <**1 second**>, while observing the voltmeter. Record line voltage during exposure, as "Vl" (voltage under load).

> **NOTE:**
> To calculate the line drop correctly in the following formula, note that the ratio is multiplied by 200, instead of 100. This compensates for making the exposure at 75 kVp, or 50% of "maximum load", of the allowable kVp (150 kVp).

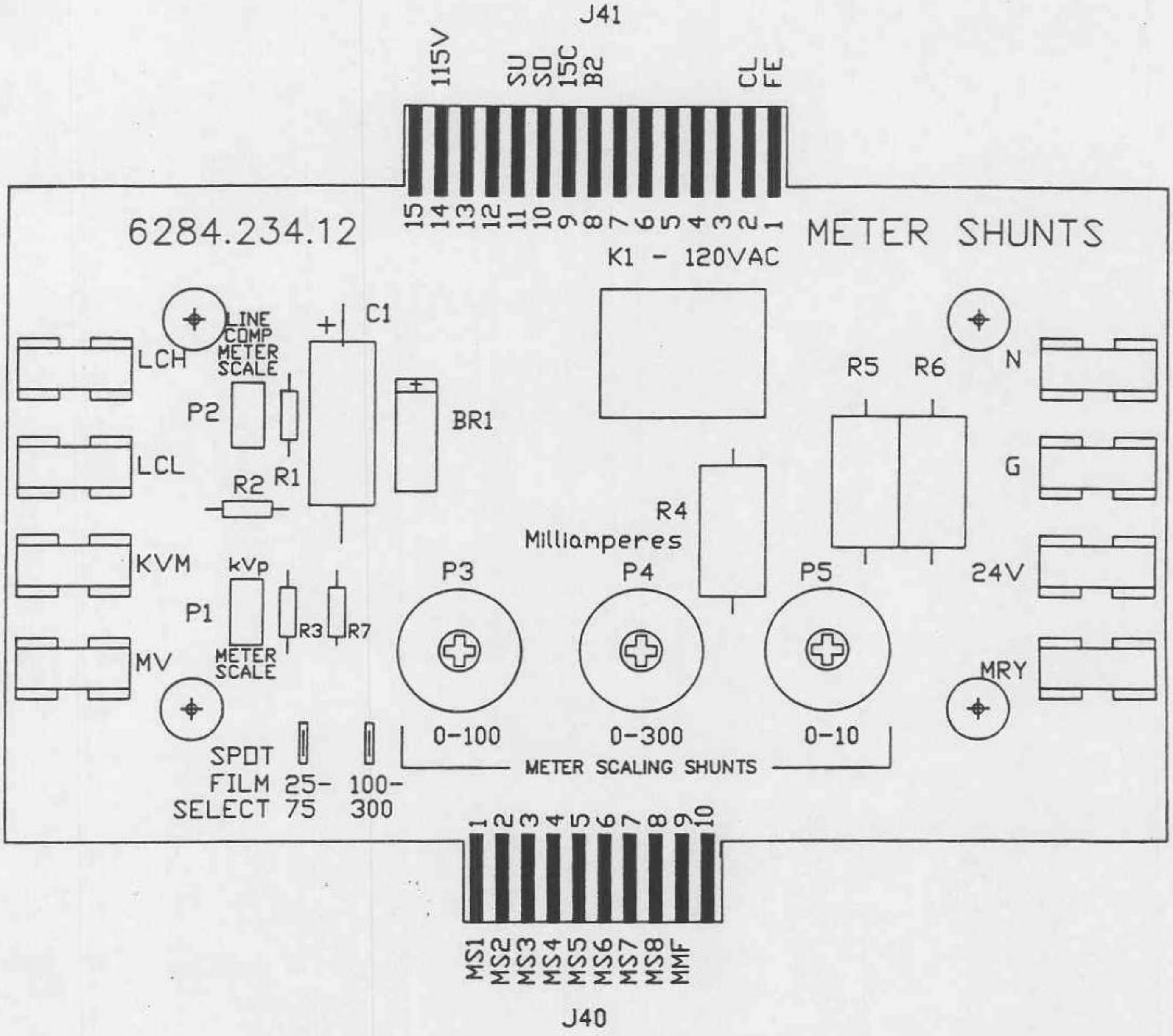
6. No Load (Vnl):____________ Load (Vl)________________

Calculate line drop using this formula:

$$\frac{(Vnl - Vl)}{Vnl} \times 200 = \%\ \text{Line Drop}$$

7. Use the calculated percentage line drop to select the closest kVp calibration table (**TABLE 2-8**) to use during calibration of kVp compensation.

page 2-57


J41
115V
SU
SD
15C
B2
CL
FE
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
6284.234.12
METER SHUNTS
K1 - 120VAC
C1
LINE COMP METER SCALE
LCH
P2
BR1
R1
R2
LCL
R5
R6
N
G
R4
Milliamperes
KVM
kVp
P1
R3
R7
METER SCALE
MV
P3
P4
P5
24V
MRY
0-100
0-300
0-10
METER SCALING SHUNTS
SPDT
FILM
SELECT
25-75
100-300
1 2 3 4 5 6 7 8 9 10
MS1
MS2
MS3
MS4
MS5
MS6
MS7
MS8
MMF
J40

6284.234.12

FIGURE 2-6 mA/kVp/LINE METER SHUNT PCB

2.1.5 TUBE ROTOR BOOST TIME ADJUSTMENT

The adjustments in this section are performed on the Rotor Control PCB (6284.234.09), **FIGURE 2-7**. Its placement is shown in **FIGURE 2-1**, front view.

2.1.5.1 OVER-TABLE TUBE ROTOR BOOST TIME ADJUSTMENT

Turn [**MAINS**] off.

Connect a scope probe and an AC voltmeter across O7 and N on the Rotor Control PCB (6284.234.09), **FIGURE 2-7**. Set the voltmeter to read at least 300 volts AC. Set the scope to display 100 volts/division, at a sweep rate of 200 msec/division. All meter readings in this section should be within 5% tolerance to be considered acceptable.

Turn [**MAINS**] on.

1. Select the [**200L**] mA station, **<80 kVp>**, **<1/10th second>**.

2. Press [**PREPARE**]. The scope should display 650 volts AC peak-to-peak for 1.5 seconds; then drop to 150 volts AC peak-to-peak (see **FIGURE 2-8**).

   If these readings are satisfactory, proceed to Section 2.1.5.2.

3. Locate potentiometer (pot) **P1** (Boost Time) on the Rotor Control PCB. Using the same technique ([**200L**] mA, **<80 kVp>** and **<1/10th second>**), press and hold [**PREPARE**].

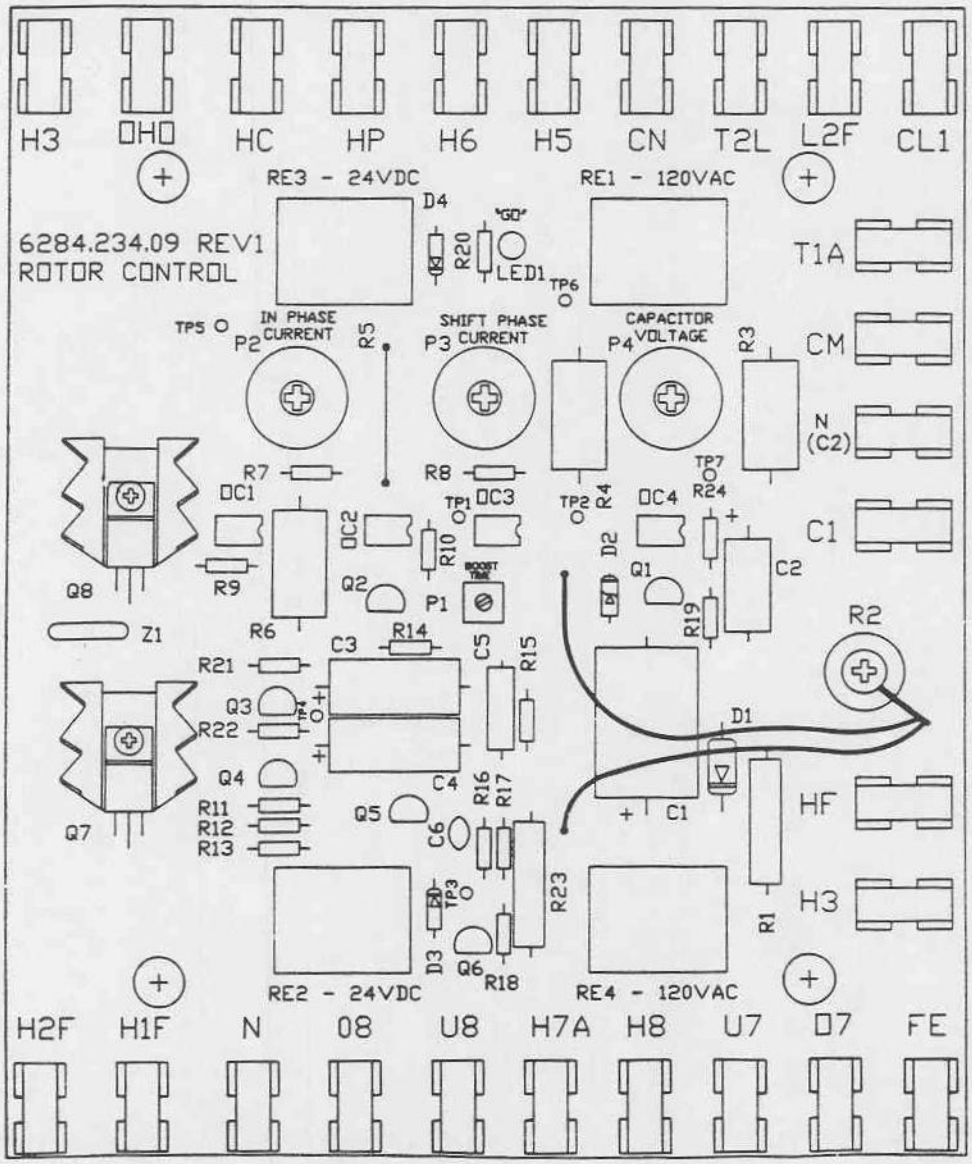
   Adjust pot **P1** for a **1.5** (± .1 sec) second boost time. At the **END** of the Boost time, the green lamp in the [**PREPARE**] push button should illuminate.

WARNING

Turn [MAINS] OFF before performing the following step. Adjust the resistor with the power OFF.

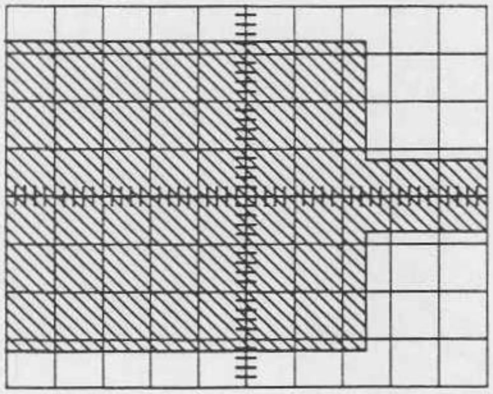
Do NOT turn [**MAINS**] ON to read the setting until HANDS ARE CLEAR.

Several attempts may be necessary.


H3
DHD
HC
HP
H6
H5
CN
T2L
L2F
CL1
RE3 - 24VDC
RE1 - 120VAC
D4
"GO"
R20
LED1
TP6
6284.234.09 REV1
ROTOR CONTROL
T1A
TP5
IN PHASE CURRENT
P2
R5
SHIFT PHASE CURRENT
P3
CAPACITOR VOLTAGE
P4
R3
CM
N (C2)
R7
R8
TP7
R24
DC1
TP1
DC3
TP2
R4
DC4
C1
DC2
R10
D2
Q8
R9
Q2
BOOST TIME
P1
Q1
C2
R19
R2
Z1
R6
C3
R14
C5
R15
R21
D1
Q3
TP4
R22
Q4
C4
R16
R17
HF
R11
R12
R13
Q5
C6
C1
Q7
TP3
R23
H3
R1
D3
Q6
R18
RE2 - 24VDC
RE4 - 120VAC
H2F
H1F
N
08
U8
H7A
H8
U7
D7
FE

6284.234.09

FIGURE 2-7 ROTOR CONTROL PCB



100 volts/division; 200 msec/division

FIGURE 2-8 SAMPLE WAVEFORM FOR 2.1.5.1 STEP 2

2.1.5.1 OVER-TABLE TUBE ROTOR BOOST TIME ADJUSTMENT (continued)

4. Using the voltmeter, adjust the 10 ohm 100 watt Rotor Run resistor shown in **FIGURE 2-1**, left side view, located immediately below the left side cooling fan, inside the main control, for 50 (± 2) volts AC rotor run voltage.

NOTE::

There is not an adjustment for Rotor Boost Voltage.

5. With the **[PREPARE]** button depressed, adjust pot P2 (In-Phase Current) on the Rotor Control PCB counterclockwise until the **[PREPARE]** lamp goes out, and then back clockwise until the lamp illuminates again.

Over adjust slightly in the ON direction (CW).

6. With the **[PREPARE]** button depressed, adjust pot P3 ("shift phase current") on the Rotor Control PCB counterclockwise until the **[PREPARE]** lamp goes out, and then back clockwise until the lamp illuminates again.

Over adjust slightly in the ON direction (CW).

7. Turn **[MAINS]** off. Install a jumper wire between H7A and H8 on the Rotor Control PCB. Turn **[MAINS]** on and press **[PREPARE]**. Verify that the **[PREPARE]** push button does not light. If **[PREPARE]** illuminates, repeat the above steps until it does not.

9. Turn **[MAINS]** off. Remove the AC voltmeter and jumper wire from H7A and H8.

2.1.5.2 UNDER-TABLE TUBE ROTOR BOOST TIME ADJUSTMENT

should be
U7

If not connected from **Section 2.1.5.1**, connect a scope probe and an AC voltmeter across O7 and N on the Rotor Control PCB (6284.234.09), **FIGURE 2-7**. Set the voltmeter to read at least 300 volts AC. Set the scope to display 100 volts/division, at a sweep rate of 200 msec/division All meter readings in this section should be within 5% tolerance to be considered acceptable.

2.1.5.2 UNDER-TABLE TUBE ROTOR BOOST TIME ADJUSTMENT (continued)

Turn [**MAINS**] on.

1. Select [**200L SPOT**] mA, **<80 kVp>**, **<1/10th second>**. The green LED ("GO" - LED1) on the Rotor Control PCB (6284.234.09), **FIGURE 2-7**, should be illuminated 1.5 seconds after the SPOT mA station is selected, and continuously thereafter.

2. The voltmeter should display 230 volts AC (boost voltage) for approximately 1.5 seconds beginning when the 200L SPOT mA station is selected, then drop to 50 volts AC (run voltage).

3. The scope should display 650 volts AC peak-to-peak for 7.5 divisions; then drop to 150 volts AC peak-to-peak (see **FIGURE 2-8**).

If these readings are satisfactory, proceed to **Section 2.1.6**, otherwise repeat **Section 2.1.5.1 Step 4** as necessary.

2.1.6 ADJUST RADIOGRAPHIC kVp AND mA METERS

NOTE:

The accuracy of this adjustment is critical to the following steps in the calibration procedure.

The voltage measurement and adjustment points for the radiographic kVp meter are on the mA/kVp/Line Shunt Meter PCB (6284.234.12), **FIGURE 2-6**. See **FIGURE 2-2, D**, for location of the board.

1. With the [**MAINS**] off, connect a voltmeter across MRY and MV on the mA/kVp/Line Shunt Meter PCB (6284.234.12), **FIGURE 2-6**, with the positive lead on MRY. Set the voltmeter range to read at least 50 volts DC.

2. Turn [**MAINS**] on. Select [**25S**] mA and **<1/10 second>**.

3. Rotate the major and minor kVp selector switches (**FIGURE 2-2**, view **G**), until 50 volts DC (±0.3 volts) is read on the voltmeter. Adjust P1 (Meter Scale) on the mA/kVp/Line Shunt Meter PCB (6284.234.12), **FIGURE 2-6**, for 150 kVp. The radiographic kVp meter is now calibrated.

2.1.6 ADJUST RADIOGRAPHIC kVp AND mA METERS (continued)

4. Turn [**MAINS**] off. Disconnect the power cable and the control cable, P22 and P23 connectors, at the high voltage transformer. Disconnect M1 on the main terminal strip, on the lower inside of the control. Remove the card edge connector from the left side of the Exposure Interlock PCB (6284.234.04), **FIGURE 2-9** (for location, see **FIGURE 2-2**, inside door).

5. On the Exposure Interlock PCB (6824.234.04), connect an ohmmeter between terminals J29-2 and J29-6. Adjust potentiometer (pot) P4 on Exposure Interlock PCB (6284.234.04) until the ohmmeter reads 6,000 ohms resistance. Reconnect the card edge connector.

6. Connect a DC milliammeter to terminal M1 in series with the positive lead of an adjustable DC current source. Connect the negative lead of the current source to G (any convenient ground source on the terminal strip). Depending on the type of current source used, it may be necessary to readjust the current source after the pot adjustment.

7. Turn [**MAINS**] on. Select [**200L SPOT**]. Set the current source to 7.5 mA, as read on the milliammeter. Read the control's mA meter on the 10 mA scale, and adjust the pot P5, on mA/KVP/Line Meter Shunt (6284.234.12), **FIGURE 2-6**, until it reads 7.5 mA.

8. Select [**50S**] mA. Adjust the current source for 75 mA, as read on the milliammeter. Adjust potentiometer P3, on mA/KVP/Line Meter Shunt (6284.234.12), until 75 mA is read on the 100 mA scale of the control's mA meter.

9. Select [**300L**] mA station. Adjust the current source for 300 mA, as read on the milliammeter. Adjust pot P4, on mA/KVP/Line Meter Shunt (6284.234.12), until 300 mA is read on the 400 mA scale of the control's mA meter.

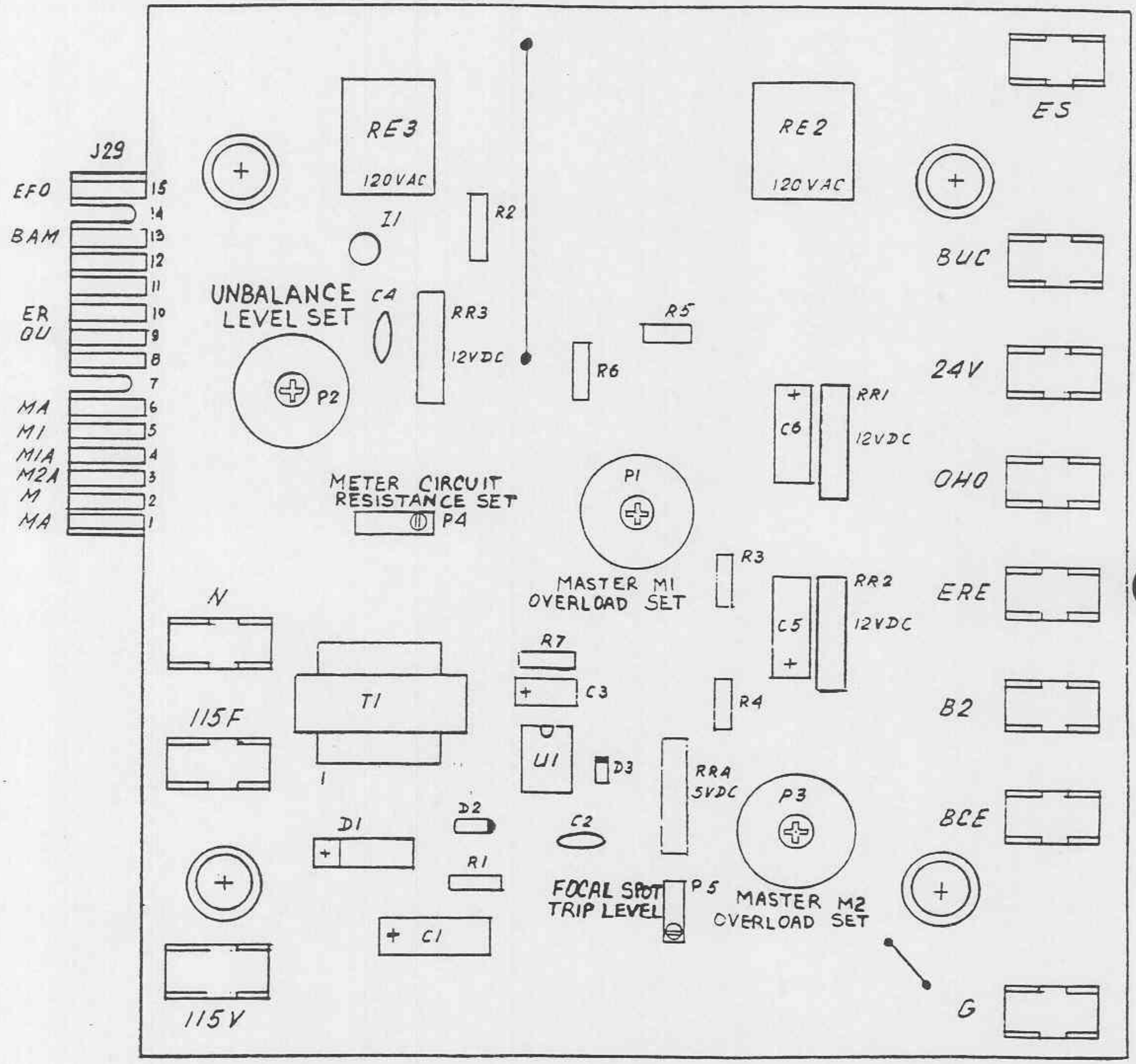
10. Turn [**MAINS**] off.

11. Reconnect P22 and P23 to the high voltage transformer.

2.1.7 mA OVERLOAD ADJUSTMENT

There are three separate mA overload sensing systems, the M1 overall, the M2 overall, and the focal spot overload. Each system has its own adjustments.

1. Be sure [**MAINS**] is off. Leave or install the current source (from **Section 2.1.6 step 6**) on M1 and G on the main terminal strip.


J29
EFO
BAM
ER
OU
MA
MI
M1A
M2A
M
MA
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
RE3
120VAC
I1
R2
RE2
120VAC
ES
BUC
24V
OHO
ERE
B2
BCE
G
UNBALANCE
LEVEL SET
C4
RR3
12VDC
P2
R5
R6
RR1
12VDC
C6
METER CIRCUIT
RESISTANCE SET
P4
P1
MASTER M1
OVERLOAD SET
R3
RR2
12VDC
C5
N
115F
T1
R7
C3
R4
U1
D3
RRA
5VDC
P3
D1
D2
C2
R1
FOCAL SPOT
TRIP LEVEL
P5
MASTER M2
OVERLOAD SET
C1
115V

6284.234.04

FIGURE 2-9 EXPOSURE INTERLOCK PCB

2.1.7 mA OVERLOAD ADJUSTMENT (continued)

2. On the Exposure Interlock PCB (6824.234.04), **FIGURE 2-9**, connect a jumper wire from M1A (negative end of C6) and terminal G on the board. This will bypass the focal spot overload.

3. Turn **[MAINS]** on. Select **[300L]** mA. Adjust the current source to 360 mA. Adjust pot P1, on the Exposure Interlock PCB (6284.234.04), **FIGURE 2-9**, until **SAFETY RESET** illuminates, and will not for values less than 360 mA.

To reset **SAFETY RESET**, reduce the mA input current and press the **SAFETY RESET** button on the control panel.

The M1 overall protection has now been set.

4. Turn **[MAINS]** off. Remove the jumper wire and reconnect it between M1 and M1A on the main terminal strip. This will bypass the M1 overload. Turn **[MAINS]** on. Adjust the current source again for 360 mA. Adjust pot P5, on the Exposure Interlock PCB (6284.234.04), **FIGURE 2-9**, as above, so that **SAFETY RESET** illuminates above 360 mA, and will not for values below 360 mA.

Turn **[MAINS]** off. Remove the jumper wire. The focal spot overload is now set.

5. Connect the negative lead of the current source to M2 and the positive lead to G on the main terminal strip located in the lower inside of the control. Turn **[MAINS]** on. Adjust the current source to 360 mA. Adjust pot P3, on the Exposure Interlock PCB (6284.234.04), **FIGURE 2-9**, so that **SAFETY RESET** illuminates above 360 mA, and will not for values below 360 mA.

Turn **[MAINS]** off. Remove all jumper wires. The M2 overload is now set.

2.1.8 END OF EXPOSURE SIGNAL ☢

Make a radiographic exposure. For CDRH compliance, an audible signal **MUST** be heard to indicate an exposure has taken place.

1. If the audible signal is too long or too short, adjust pot P1 (Duration) for signal tone duration on the Exposure End Buzzer PCB (5184.234.2901), **FIGURE 2-10**.

2. If the audible signal is too loud or too soft, adjust pot P2 (Loudness) for tone volume on the Exposure End Buzzer PCB (5184.234.2901).

Turn [**MAINS**] off.

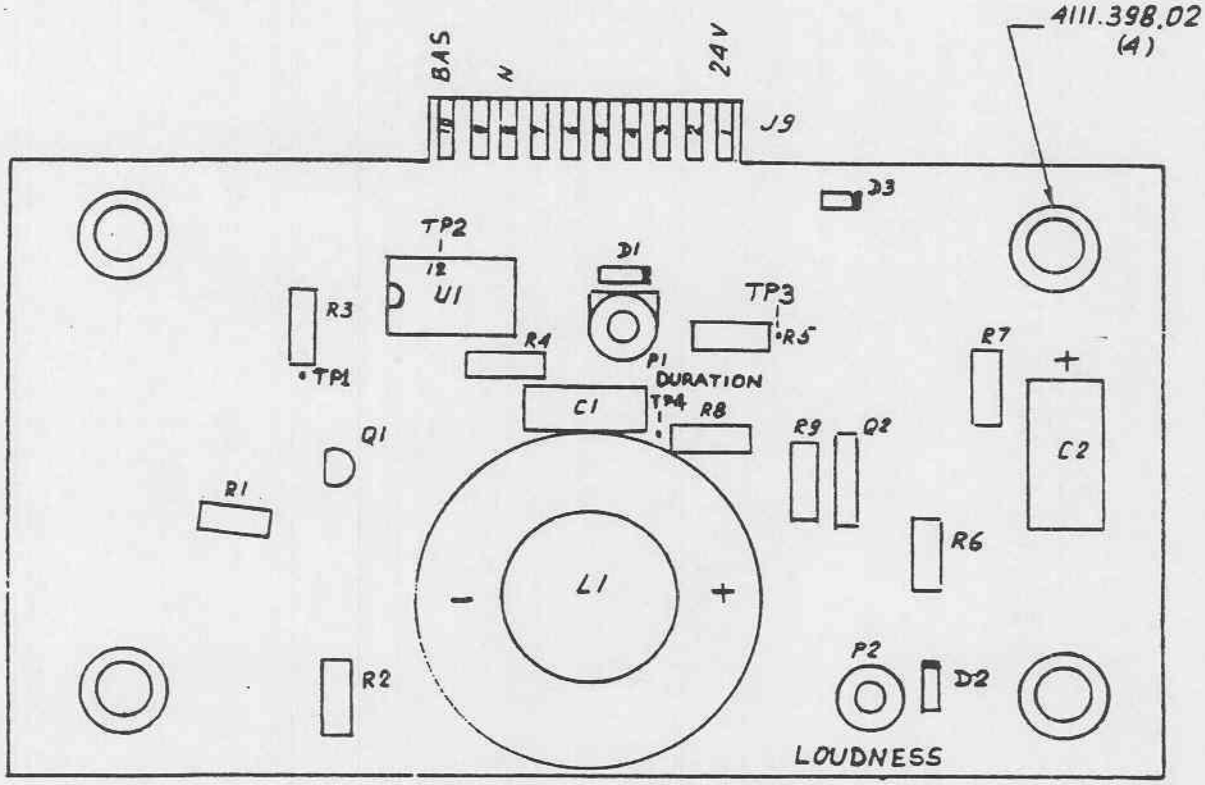
2.1.9 TUBE OVERLOAD ADJUSTMENTS (TOLA) ☢

The **MXR-350 X-ray Generator** is designed to prevent damage from excessive x-ray exposures to the two x-ray tubes it controls. The Tube Rating Charts located in **Chapter 15**, Volume II of this Manual, define safe exposure limits for both the over-table and under-table x-ray tubes.

Each mA station has a maximum allowable time per kVp, and a maximum allowable kVp per time. The point at which an unsafe exposure is prevented is controlled by a series of pots located on the **TOLA ASSEMBLY PCB** (6284.234.01). See **FIGURE 2-1** for the location of the board in the control. A layout of the TOLA PCB is shown in **FIGURE 2-11.**

TABLE 2-1 TOLA ADJUSTMENTS lists the point of maximum allowable tube exposure. The table lists two settings for each mA station, one for maximum allowable kVp, with its concurrent maximum time, and the second for maximum allowable time at its highest concurrent kVp.

The tube limits are also affected by power frequency, with different settings for 60 Hz and 50 Hz operation. Use the appropriate data from **TABLE 2-1** for the power frequency is use.


4111.398.02
(4)
BAS
24V
J9
D3
TP2
12
U1
D1
TP3
R3
R4
R5
P1
DURATION
TP1
C1
TP4
R8
R7
+
R9
Q2
C2
Q1
R1
R6
L1
-
+
R2
P2
D2
LOUDNESS

5184.234.2901

FIGURE 2-10 EXPOSURE END BUZZER

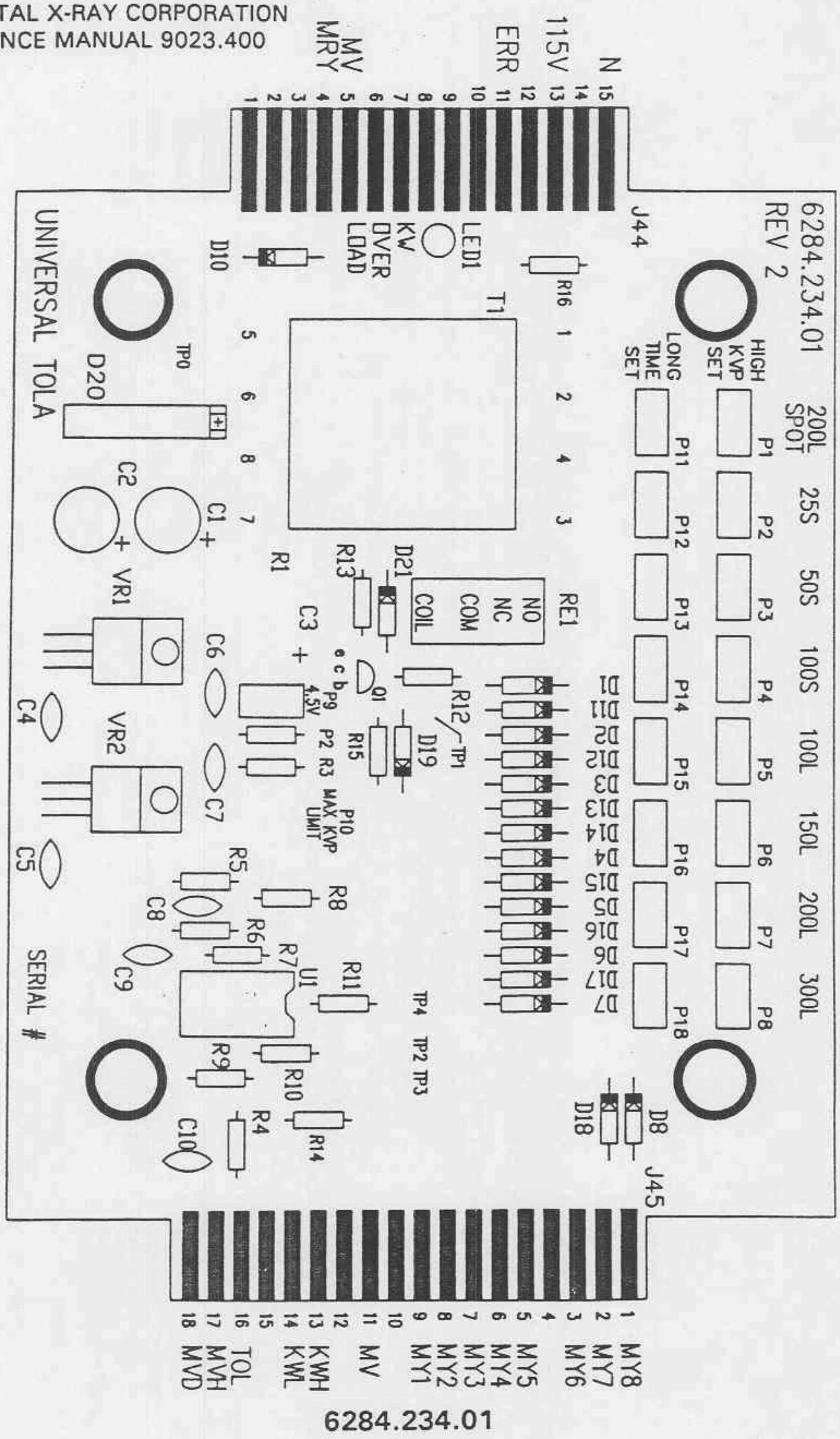

MV
MRY
ERR
115V
N
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
J44
6284.234.01
REV 2
HIGH KVP SET
LONG TIME SET
200L SPOT
25S
50S
100S
100L
150L
200L
300L
P1 P2 P3 P4 P5 P6 P7 P8
P11 P12 P13 P14 P15 P16 P17 P18
LED1
KW OVER LOAD
D10
R16
T1
1 2 4 3
5 6 8 7
TP0
D20
UNIVERSAL TOLA
C1
C2
VR1
VR2
C4
C5
C6
C7
R1
R13
D21
RE1
NO
NC
COM
COIL
C3
Q1
e c b
P9 4.5V
R12
TP1
D19
R15
P2 R3
P10 MAX KVP LIMIT
D1 D11 D2 D12 D3 D13 D14 D4 D15 D5 D16 D6 D17 D7
R5
R8
C8
R6
R7
C9
R11
U1
TP4 TP2 TP3
SERIAL #
R9
R10
R4
R14
C10
D8
D18
J45
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
MY8
MY7
MY6
MY5
MY4
MY3
MY2
MY1
MV
KWH
KWL
TOL
MVH
MVD
6284.234.01

FIGURE 2-11 UNIVERSAL TOLA PCB

2.1.9 TUBE OVERLOAD ADJUSTMENTS (TOLA) (continued)

	MAXIMUM kVp					MAXIMUM TIME				
mA	60Hz		50Hz		POT	60Hz		50Hz		POT
STATION	kVp	TIME	kVp	TIME	ADJ	kVp	TIME	kVp	TIME	ADJ
200L SPOT	149	2/3	142	3/5	P1	65	8.0	65	8.0	P11
25S	149	8.0	149	8.0	P2	149	8.0	149	8.0	P12
50S	149	8.0	149	6.0	P3	149	8.0	143	8.0	P13
100S	146	1-1/2	149	1.0	P4	85	8.0	72	8.0	P14
100L	149	8.0	149	8.0	P5	149	8.0	149	8.0	P15
150L	144	3.0	143	1.0	P6	106	8.0	106	8.0	P16
200L	149	1.0	143	1.0	P7	82	8.0	77	8.0	P17
300L	149	2/15	149	2/25	P8	55	8.0	55	6.0	P18

TABLE 2-1 TOLA ADJUSTMENTS

The **SAFETY RESET** lamp (**D**, in **FIGURE 2-3**) should **NOT** illuminate when exposures are made at any of the techniques shown in **TABLE 2-1**. If the **SAFETY RESET** lamp illuminates at these settings, adjust the pot indicated in the Table until it goes out.

If the techniques shown are increased by one mA station, or three kVp, or one time station, the **SAFETY RESET** lamp **SHOULD** illuminate. If the lamp fails to illuminate at the increased setting, adjust the pot indicated in **TABLE 2-1**.

Turn [**MAINS**] off.

2.1.10 RADIOGRAPHIC TIMER (50Hz and 60Hz) VERIFICATION ☢

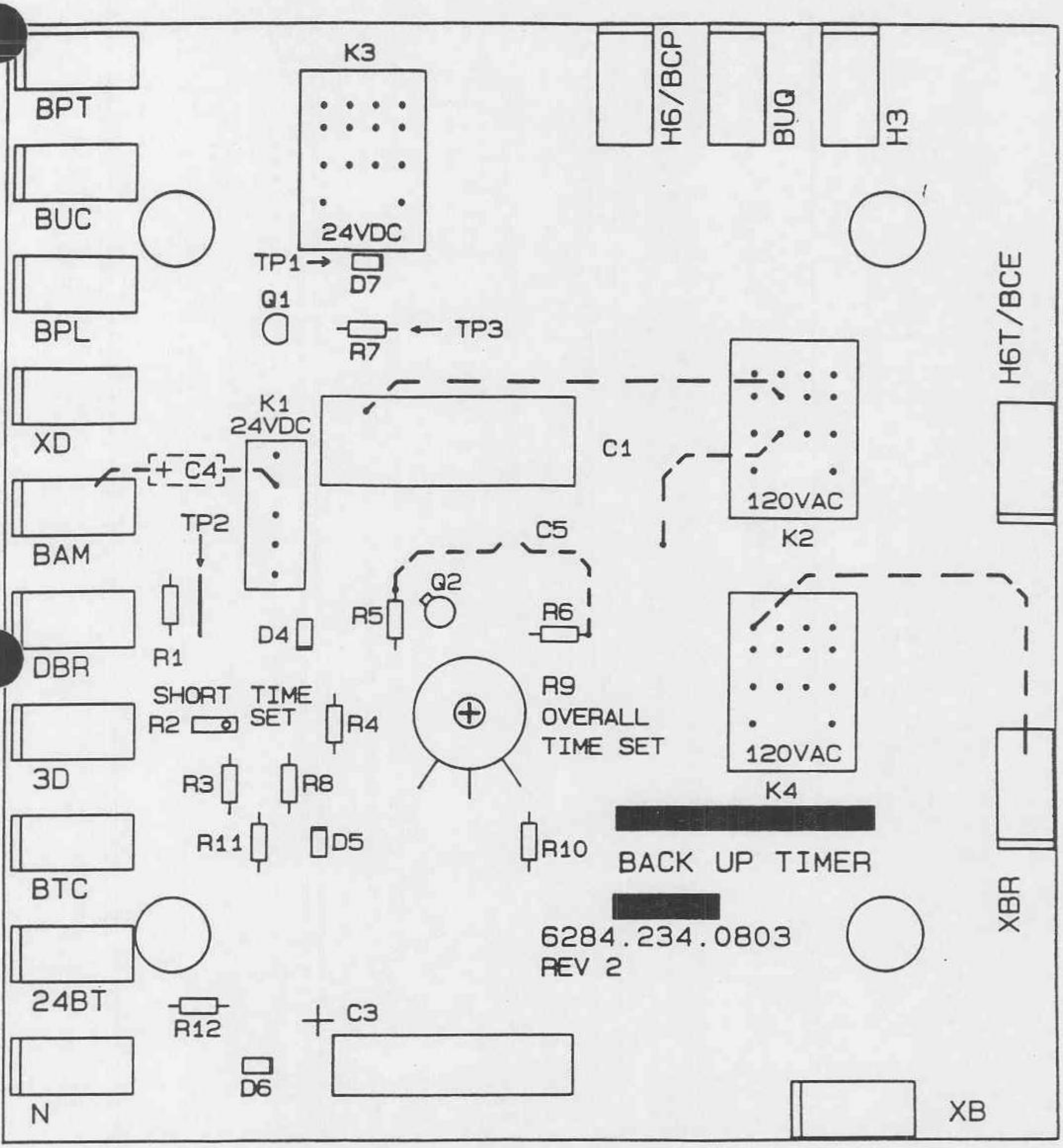
Turn [**MAINS**] off. Locate the Back-up Timer PCB (6284.234.0803), per **FIGURE 2-1**, front view, in the main control. Disable the Back-up Timer by removing lead 3D from its terminal, reference **FIGURE 2-12.**

Turn [**MAINS**] on.

1. Select <**85 kVp**> and [**150L**] mA. Place the x-ray calibration timer in the center of the x-ray beam.
2. Make an exposure at <**1/120 second**>. This should be precisely **one** impulse.
3. Make an exposure at <**1/60 second**>. This should be precisely **two** impulses.
4. Make an exposure at <**2 seconds**> (240 impulses). The x-ray calibration timer should read between 235 and 245 impulses (±2%).

If these readings are correct, turn OFF the [MAINS]. Reconnect lead 3D to its terminal on the Back-up Timer PCB (6284.234.0803). Proceed to **Section 2.1.13,** 60 Hz Back-up Timer, or **Section 2.1.14** for the 50 Hz Back-up Timer.

If they are **NOT**, continue with **Section 2.1.11** if the system is operating at 60 Hz, or **Section 2.1.12** if using 50 Hz power.


BPT
BUC
BPL
XD
BAM
DBR
3D
BTC
24BT
N
K3
24VDC
TP1
D7
Q1
R7
TP3
K1
24VDC
C4
TP2
R1
D4
SHORT TIME SET
R2
R3
R4
R8
R11
D5
R12
D6
C3
C1
C5
Q2
R5
R6
R9
OVERALL
TIME SET
R10
H6/BCP
BUQ
H3
H6T/BCE
120VAC
K2
120VAC
K4
[redacted]
BACK UP TIMER
[redacted]
6284.234.0803
REV 2
XBR
XB

6284.234.0803

FIGURE 2-12 BACK-UP TIMER PCB

2.1.11 60 Hz RADIOGRAPHIC TIMER CALIBRATION

Turn [**MAINS**] off. Locate the Back-up Timer PCB (6284.234.0803), per **FIGURE 2-1**, front view, in the main control. Disable the Back-up Timer by removing lead 3D from its terminal, reference **FIGURE 2-12**.

Set the scope to 5 volts/division, vertical and 200 msec/division, horizontal, and connect the probe to M1 and the shield to G on the terminal strip.

Turn [**MAINS**] on.

1. Select [**200L**] mA, <**80 kVp**>, and <**1 second**> technique.
   If the SAFETY RESET lamp illuminates, refer to Section 2.1.9.

2. Press [**PREPARE**] and [**EXPOSE**] together. The display on the scope should look like **FIGURE 2-13**, sample scope waveform. The waveform should be high at the start of the exposure, remain high for the duration of the exposure and return low at the end of the exposure.

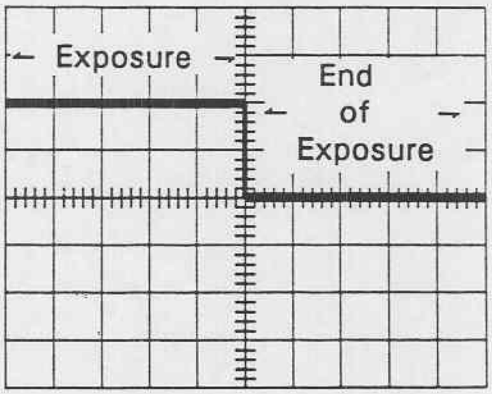


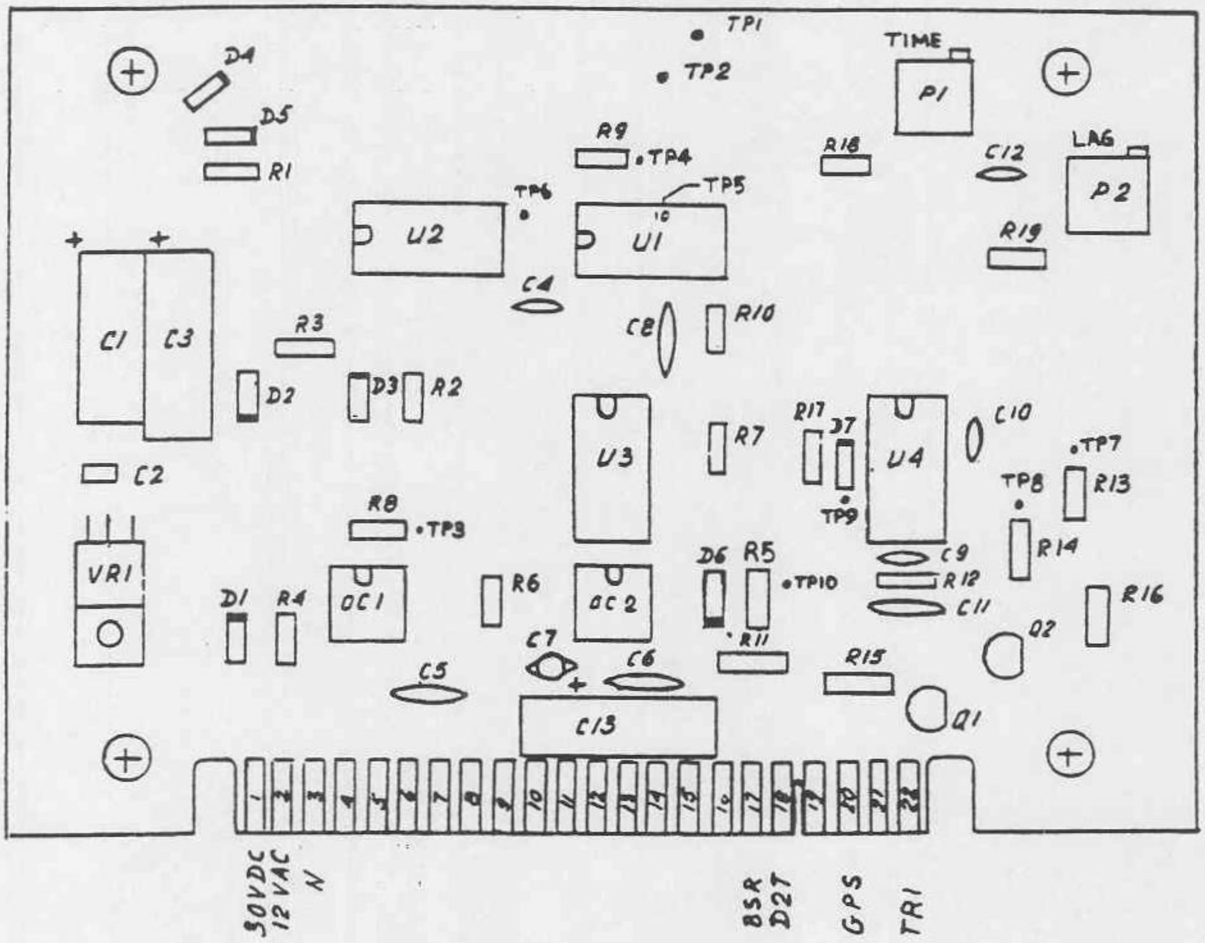
FIGURE 2-13 SAMPLE WAVEFORM FOR 2.1.11 & 2.1.12 STEP 2

The duration of the high should be 1 second, ±5%. If not, adjust pot P1 (Overall Time) on the Single Phase Impulse Timer PCB (5184.234.12), **FIGURE 2-14**.

3. Select <**1/120th second**> on the time select dial with the remaining technique factors unchanged.

   If the SAFETY RESET lamp illuminates, refer to Section 2.1.9.

4. Set the horizontal sweep on the scope to 2 msec/division.


TP1
TP2
TIME
P1
D4
D5
R1
R9
TP4
R18
C12
LAG
P2
TP6
TP5
10
U2
U1
R19
C1
C3
C4
C8
R10
R3
D2
D3
R2
R17
D7
C10
R7
U3
U4
TP7
C2
TP9
TP8
R13
R8
TP3
VR1
D6
R5
R14
R6
C9
D1
R4
OC1
OC2
TP10
R12
C11
R16
C7
R11
Q2
C5
C6
R15
C13
Q1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
30VDC
12VAC
N
BSR
D2T
GPS
TRI

5184.234.12

FIGURE 2-14 SINGLE PHASE IMPULSE TIMER

2.1.11 60 Hz RADIOGRAPHIC TIMER CALIBRATION (continued)

5. Press **[PREPARE]** and **[EXPOSE]**. The waveform on the scope should be high for more than 6 msec and less than 8.3 msec, then return low. Reference **FIGURE 2-15** for a sample display on the scope.

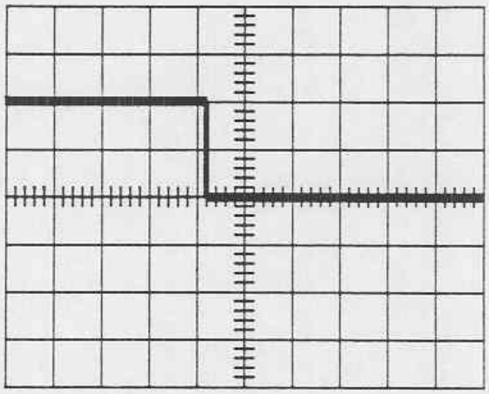


FIGURE 2-15 SAMPLE WAVEFORM FOR 2.11 STEP 5

6. If the display is NOT as described, adjust the pot P2 (Short Time) on the same PCB for the correct time.

7. If pot P2 (Short Time) was adjusted, repeat the procedures for verification of "overall" time. Repeat until satisfactory results occur for both settings.

Turn [**MAINS**] off. Reconnect lead 3D to its terminal on the Back-up Timer PCB, **FIGURE 2-12.**

Skip **Section 2.1.12** (following) for 50 Hz Radiographic Timer Calibration. Proceed to **Section 2.1.13** 60 Hz Back-up Timer Calibration.

2.1.12 50 Hz RADIOGRAPHIC TIMER CALIBRATION

NOTE::

Follow this procedure ONLY if the system is operating under 50 Hz power. If the system uses 60 Hz power, follow the instructions in Section 2.1.11.

Turn [**MAINS**] off. Disable the Back-up Timer PCB (6284.234.0803), **FIGURE 2-12,** located in the main control (**FIGURE 2-1**, front view) by removing lead 3D from its terminal.

2.1.12 50 Hz RADIOGRAPHIC TIMER CALIBRATION (continued)

Set the scope to 5 volts/division, vertical and 200 msec/division, horizontal.

Turn **[MAINS]** on.

1. Select **[200L]** mA, **<80 kVp>**, and **<1 second>**.

   If the SAFETY RESET lamp illuminates, refer to Section 2.1.9.

2. Press **[PREPARE]** and **[EXPOSE]**. The display on the scope should look like **FIGURE 2-13**, sample scope waveform. The waveform should be high at the start of exposure, remain high for the duration of the exposure and return low at the end of the exposure.

   The duration of the high should be 1 second ±5%. If not adjust pot P1 (Overall Time) on the Single Phase Impulse Timer PCB (5184.234.12), **FIGURE 2-14**, for proper exposure time.

3. Select **<1/100 second>** on the time select dial with the other technique factors unchanged.

   If the SAFETY RESET lamp illuminates, refer to Section 2.1.9.

4. Set the horizontal sweep on the scope to 2 msec/division

5. Press **[PREPARE]** and **[EXPOSE]**. Observe the waveform on the scope. It should be high for 10 msec, then return low. Refer to **FIGURE 2-16** for a sample scope waveform.

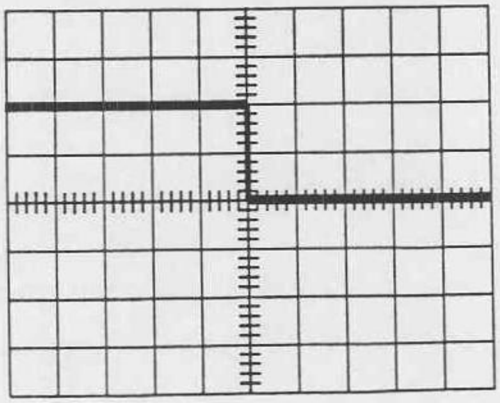


FIGURE 2-16 SAMPLE WAVEFORM FOR 2.1.12 STEP 5

2.1.12 50 Hz RADIOGRAPHIC TIMER CALIBRATION (continued) ☢

6. If the display is NOT as described, adjust pot P2 (Short Time) on the same PCB (5184.234.12), for the correct display.

7. If pot P2 (Short Time) was adjusted, repeat the procedures for verification of "overall" time. Repeat until satisfactory results occur on both settings.

Turn [**MAINS**] **OFF.** Reconnect lead 3D to its terminal on the Back-up Timer PCB (6284.234.0803), **FIGURE 2-12.**

2.1.13 60 Hz BACK-UP TIMER CALIBRATION ☢

Turn [**MAINS**] off.

1. Connect channel 2 of the scope to TP1 (bar on D7 indicates cathode of D7) on the Back-up Timer PCB (6284.234.0803), **FIGURE 2-12.**

2. Connect channel 1 of the scope to TP10 on the Single Phase Impulse Timer PCB, **FIGURE 2-14.**

3. Connect the external trigger input of the scope to terminal BAM on the SCR Impulse Timer PCB (5284.234.1102), **FIGURE 2-17.** This terminal is 24 VDC during exposure only.

4. Set channel 1 of the scope to display 5 volts/division, channel 2 to 10 volts/division, and 200 msec/division, horizontal.

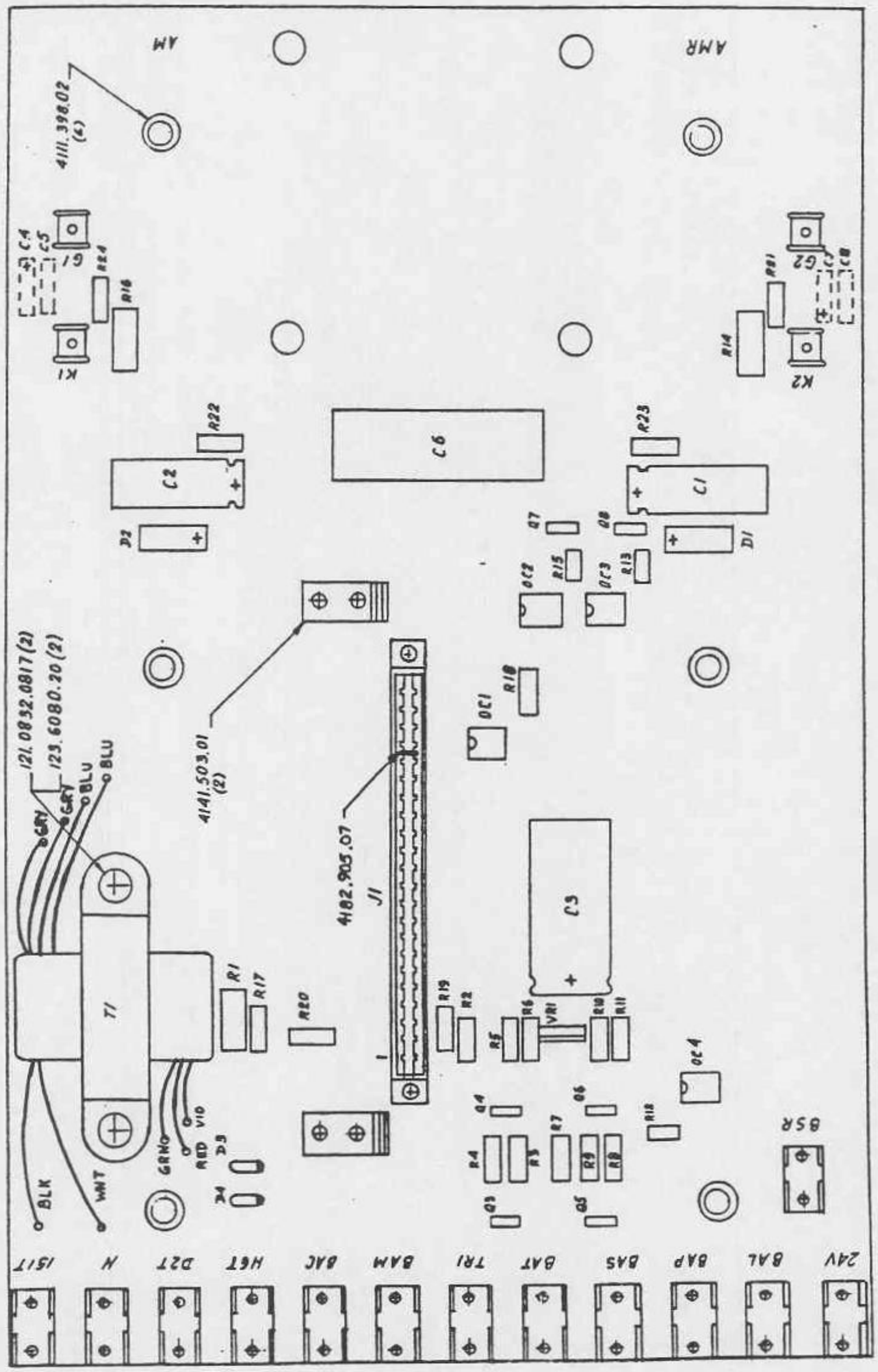
5. Turn [**MAINS**] **ON.** Select [**200L**] mA, <**80 kVp**> and <**4/5 second**>.

6. Make an exposure while observing the scope. If the display on channel 2 terminates 1.5 horizontal divisions (300 ms) after the display on channel 1, proceed to step 7. See **FIGURE 2-18** for correct scope reading.

   If it does NOT, adjust pot R9 (Overall Time Set) on the Back-up Timer PCB (6284.234.0803), **FIGURE 2-12**, and repeat step 6.

7. Select <**1/120th**> second on the time select dial leaving **ALL** technique factors the same.

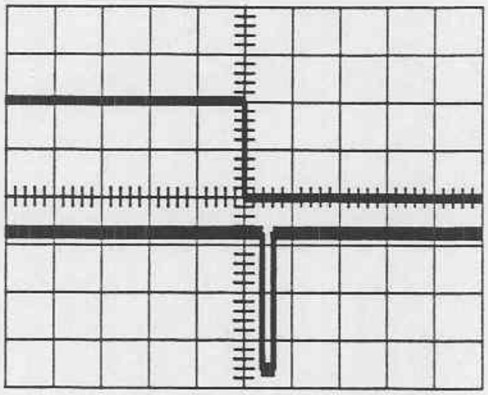
8. Set the scope to display 5msec/division leaving the vertical display as is. Set the scope to trigger on Channel 1.

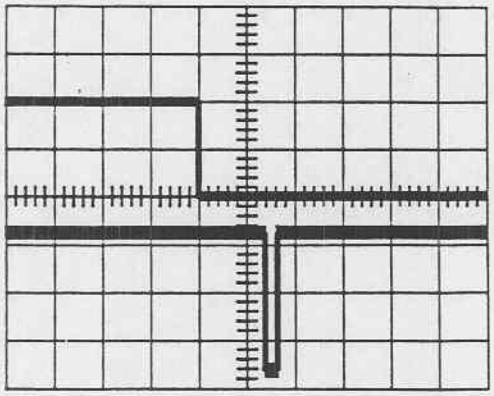

HV
AMR
4111.398.02
(4)
C4
C5
G1
R24
R16
K1
R21
G2
C8
R14
K2
R22
C6
R23
C2
C1
D2
D1
Q7
Q8
R15
R13
OC2
OC3
121.0832.0817(2)
123.6080.20(2)
GRY
GRY
BLU
BLU
4141.503.01
(2)
R18
OC1
4182.905.07
J1
C3
T1
R1
R17
R20
R19
R2
R6
VR1
R10
R11
R5
1
OC4
Q4
Q6
R12
BSR
BLK
WHT
GRN
RED
VIO
D3
D4
R4
R3
R7
R9
R8
Q3
Q5
1SIT
N
D2T
H6T
BAC
BAM
TRI
BAT
BAS
BAP
BAL
24V

5284.234.1102

FIGURE 2-17 SCR IMPULSE TIMER PCB

50 Hz





60 Hz

10 volts/division; 200 ms/division

FIGURE 2-18 SAMPLE WAVEFORMS FOR 2.1.13 and 2.1.14, STEP 6

2.1.13 60 Hz BACK-UP TIMER CALIBRATION (continued)

9. Press **[PREPARE]** and **[EXPOSE]** together while observing the scope display.

If the display on Channel 2 terminates 3 horizontal divisions (15 msec) after the display on Channel 1, proceed to step 10. Reference **FIGURE 2-19** for correct scope reading.

If it does NOT, adjust pot R2 (Short Time Set) on the Back-up Timer PCB (6284.234.0803), **FIGURE 2-12.**

If pot R2 (Short Time Set) was adjusted, select **<4/5 second>** on the time select dial. Set the scope to display 200 msec/division leaving the vertical display as is. Repeat this procedure beginning with step 2.

10. Turn **[MAINS]** off. Remove the test equipment. Reinstall the J22 connector to the high voltage transformer.

Proceed to **Section 2.2** if using non-invasive meters for calibration, or to **Section 2.3** if using a Dynalyzer™.

2.1.14 50 Hz BACK UP TIMER CALIBRATION

Turn **[MAINS]** off.

1. Connect channel 2 of the scope to TP1 (bar on D7 indicates cathode of D7) on the Back-up Timer PCB (6284.234.0803), **FIGURE 2-12.**

2. Connect channel 1 of the scope to TP10 on the Single Phase Impulse Timer PCB (5184.234.12), **FIGURE 2-14.**

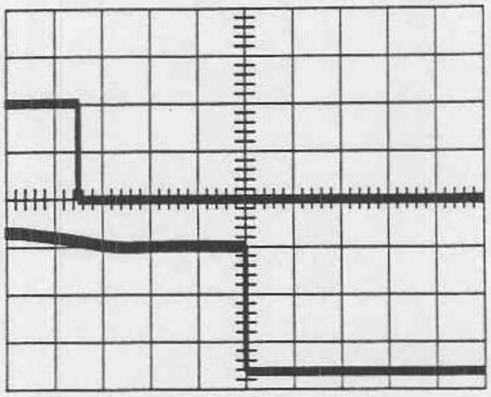
3. Connect the external trigger input of the scope to terminal BAM on the SCR Impulse Timer PCB (5284.234.1102), **FIGURE 2-17.** This terminal is 24 VDC during exposure only.

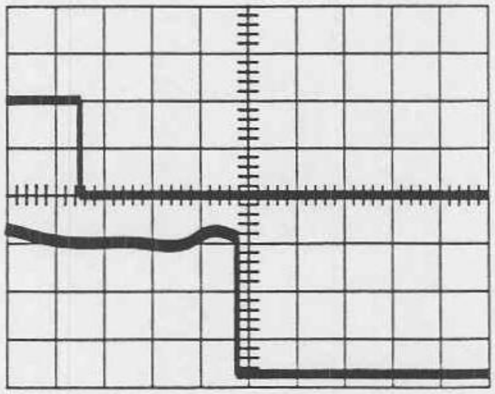
4. Set channel 1 of the scope to display 5 volts/division, channel 2 to 10 volts/division, and 200 msec/division, horizontal.

5. Turn **[MAINS] ON.** Select **[200L]** mA, **<80 kVp>**, and **<1 second>**.

6. Make an exposure while observing the scope. If the display on channel 2 terminates 0.5 horizontal divisions (100 ms) after the display on channel 1, proceed to step 7. See **FIGURE 2-18** for correct scope reading.

50 Hz





60 Hz

10 volts/division; 5 ms/division

FIGURE 2-19 SAMPLE WAVEFORMS FOR 2.1.13 and 2.1.14, STEP 9

2.1.14 50 Hz BACK UP TIMER CALIBRATION (continued)

If it does NOT, adjust pot R9 (Overall Time Set) on the Back-up Timer PCB (6284.234.0803), **FIGURE 2-12**, and repeat step 6.

7. Select **<1/100 second>** on the time select dial leaving **ALL** technique factors unchanged.

8. Set the scope to display 5 msec/division leaving the vertical display as is. Set the scope to trigger on Channel 1.

9. Press [**PREPARE**] and [**EXPOSE**] together while observing the scope display.

If the display on Channel 2 terminates 3 horizontal divisions (15 msec) after the display on Channel 1, proceed to step 10. Reference **FIGURE 2-19** for correct scope reading.

If it does NOT, adjust pot R2 (Short Time Set) on the Back-up Timer PCB (6284.234.0803), **FIGURE 2-12**.

If pot R2 (Short Time Set) was adjusted, select 1 second on the time select dial. Set the scope to display 200 msec/division leaving the vertical display as is. Repeat this procedure beginning with step 2 until satisfactory results are achieved.

10. Turn [**MAINS**] off. Remove the test equipment. Reinstall the J22 connector to the high voltage transformer.

At this point in the calibration procedure, it is necessary to follow the procedure for the type of test equipment used. If non-invasive meters are used, proceed to **Section 2.2.** If a Dynalyzer™ is used, proceed to **Section 2.3**. If calibration is to be done with only a digital voltmeter, proceed to **Section 2.4.**

2.2 CALIBRATION OF THE X-RAY GENERATOR USING NON-INVASIVE METERS

CALIBRATION WITH NON-INVASIVE METERS

Use the following instructions if calibrating the x-ray generator with non-invasive meters. If calibration will be performed using a Dynalyzer™, follow the instructions in **Section 2.3**.

Each mA station needs to be calibrated for filament control, filament boost, space charge compensation, and kVp compensation. These adjustments are interactive, and need to be performed as a set on each mA station.

X-ray current skews at different kilovoltages, due to the space charge effect. It is necessary to compensate for the space charge effect by increasing the filament level at low kVps and decreasing it at high kVps. This is performed by a series of pot adjustments.

NOTE::

TABLES 2-3, 2-5, 2-6, and 2-7 may be photocopied to record the data required by the procedures in this manual.

2.2.1 INSTALLATION OF NON-INVASIVE METERS

Regardless of the test equipment used, **ALWAYS** follow the manufacturer's instructions for installation and use, even though general instructions are given in this manual.

Turn [**MAINS**] off. Remove wire M1, located on the terminal strip on the lower section of the inside rear of the control (**FIGURE 2-1**, FRONT VIEW). Connect the meter leads of the mAs meter between the M1 terminal and the wire that was connected to the M1 terminal.

The non-invasive kVp meter should be positioned in the x-ray beam the indicated distance away from the x-ray tube as specified by the Focal Detector Distance (FDD) in the text.

2.2.2 OVER-TABLE FILAMENT CONTROL CALIBRATION

> **NOTE:**
>
> **Perform the following calibration steps only after verifying the radiographic timer, Sections 2.1.10 though 2.1.12.**

The filament adjustment pots are located on the Constant Current Filament Control PCB (6284.234.1009), **FIGURE 2-20**. The PCB is physically located in the main control, **FIGURE 2-1**, front view.

The filament adjustments are explained in the following sections.

2.2.3 SPACE CHARGE ZERO ADJUST

1. Turn **[MAINS]** off. Connect a digital voltmeter across leads XD1 (22,J3) and XCC (7,J4) on the Constant Current Filament Control PCB, (6284.234.1009), **FIGURE 2-20**.

2. Turn **[MAINS]** on. Select **[25S]** mA, **<78 kVp>**, and **<2 seconds>**.

3. Adjust P30 (Space Charge Zero Adjust) on the Constant Current Filament Control PCB (6284.234.1009), **FIGURE 2-20**, until the voltmeter reads (0) volts.

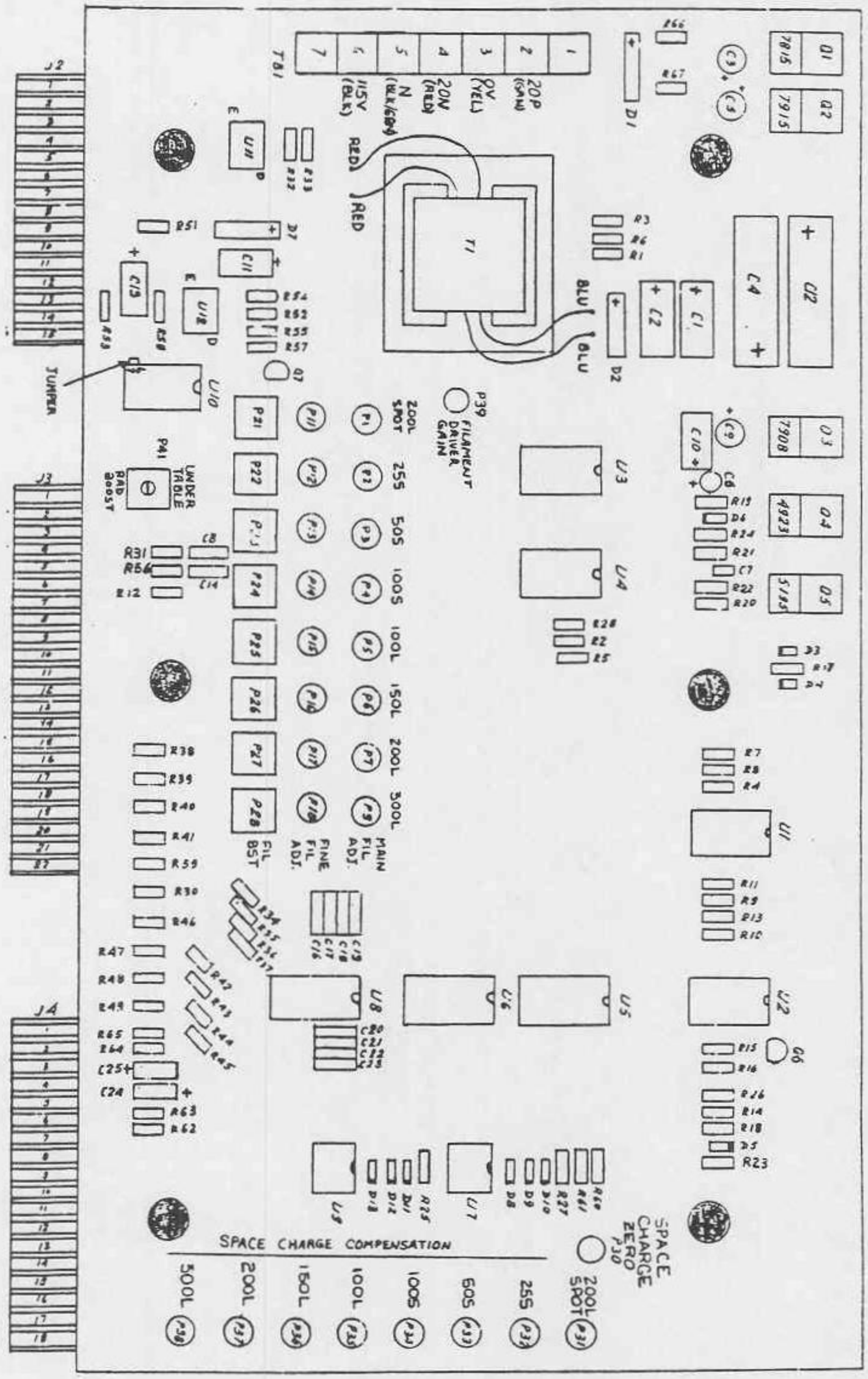
   This is the zero space charge point and needs to be set only once.

4. Turn **[MAINS]** off. Remove the voltmeter.

2.2.4 EXPOSURE mAs CALIBRATION ☢

1. Ensure that **[MAINS]** is off. Remove wire M1, located on the terminal strip on the lower section of the inside rear of the control (**FIGURE 2-1**, FRONT VIEW). Install the leads of Nuclear Associates mAs Meter (Model 07-472) between the M1 terminal and the wire that was connected to the M1 terminal. in series with the M1 lead.

2. Turn **[MAINS]** on. Select **[100L]**, **<1/2 second>**, and **<80 kVp>**.


TB1
1
2
3
4
5
6
7
20P (GRN)
0V (YEL)
20N (RED)
N (BLK/GRY)
115V (BLK)
RED
RED
BLU
BLU
T1
Q1 7815
Q2 7915
C4
C2
C1
D1
D2
Q3 7908
Q4 4923
Q5 5115
Q6
Q7
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
J2
J3
J4
JUMPER
PA1
UNDER TABLE
RAD BOOST
P39 FILAMENT DRIVER GAIN
200L SPOT
25S
50S
100S
100L
150L
200L
500L
MAIN FIL. ADJ.
FINE FIL ADJ.
FIL BST
SPACE CHARGE COMPENSATION
SPACE CHARGE ZERO P30

6284.234.1009

FIGURE 2-20 CONSTANT CURRENT FILAMENT CONTROL PCB

2.2.4 EXPOSURE mAs CALIBRATION (continued)

3. Press and hold the mAs pushbutton while making an exposure. Observe the mAs meter while holding **[PREPARE]**, **[EXPOSE]**, and [mAs] after the exposure ends. It should read 50 mAs ±5%.

4. If the mAs meter on the control panel drifts up or down, adjust pot P2 (Drift) accordingly, on the mAs Current Integrator PCB, **FIGURE 2-21**.

5. Release all buttons, and press **mAs** only. The mAs meter should read zero. Adjust pot P1 (Zero Adjustment) on the mAs Current Integrator PCB, **FIGURE 2-21**, for zero indication.

6. Compare the meter reading on the control to the digital mAs meter. Adjust pot P3, on the mAs Current Integrator PCB (6184.234.0803), **FIGURE 2-21**, until the meter on the control panel equals that on the digital meter.

7. Make another exposure and adjust pot P3 (mAs Meter Adjustment) on the mAs Current Integrator PCB for 50 mAs ±5%.

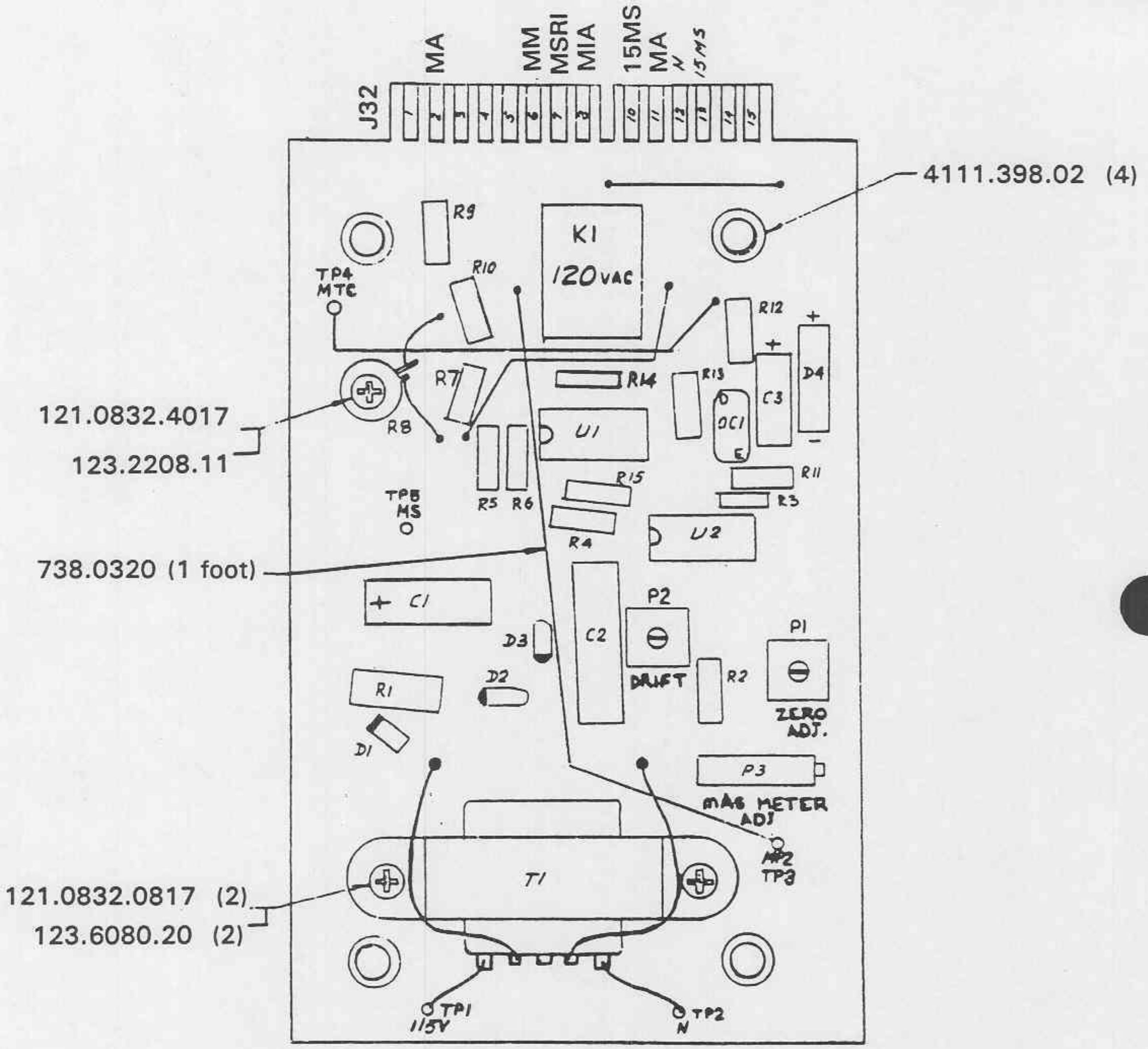
2.2.5 FILAMENT BOOST ADJUSTMENT

The following procedure allows adjustment of filament boost using only a storage scope.

1. Ensure that **[MAINS]** is off. Connect channel 1 of a storage scope to M1 located on the terminal strip on the lower section of the inside rear of the control (**FIGURE 2-1**, FRONT VIEW) and the shield to the terminal labeled G (ground).

2. **TABLE 2-2** lists the scope settings and corresponding pot used in making the adjustments. All adjustments are to be made at **<78 kVp>** and **<1/4 second>** exposure.

3. To adjust boost, start with **[25S]** mA and make an exposure. Compare the output of the scope with **FIGURE 2-22** and adjust P22 on the Constant Current Filament Control PCB (6284.234.1009), **FIGURE 2-20**, and adjust until the output matches as close as possible the waveform labelled **"CORRECT"**.


MA
MM
MSRI
MIA
15MS
MA
N
15MS
J32
1
2
3
4
5
6
7
8
10
11
12
13
14
15
4111.398.02 (4)
R9
K1
120VAC
R10
TP4
MTC
R12
+
D4
R7
R14
R13
+
C3
121.0832.4017
123.2208.11
R8
U1
OC1
-
R15
R11
TP5
MS
R5
R6
R3
R4
U2
738.0320 (1 foot)
+ C1
P2
P1
D3
C2
D2
DRIFT
R2
R1
ZERO
ADJ.
D1
P3
mAs METER
ADJ
TP2
TP3
121.0832.0817 (2)
123.6080.20 (2)
T1
TP1
115V
TP2
N

6184.234.0803

FIGURE 2-21 mAs CURRENT INTEGRATOR PCB

2.2.5 FILAMENT BOOST ADJUSTMENT (continued)

mA Station	Scope Setting	Boost Pot
25S	1 volt/division 20 ms	P22
50S	2 volts/division 20 ms	P23
100S	2 volts/division 20 ms	P24
100L	2 volts/division 20 ms	P25
150L	2 volts/division 20 ms	P26
200L	2 volts/division 20 ms	P27
300L	5 volts/division 20 ms	P28
200L SPOT	2 volts/division 20 ms	P21

TABLE 2-2 FILAMENT BOOST ADJUSTMENT

4. Using **TABLE 2-2**, continue making adjustments on all mA stations.

2.2.6 OVER-TABLE FILAMENT CALIBRATION

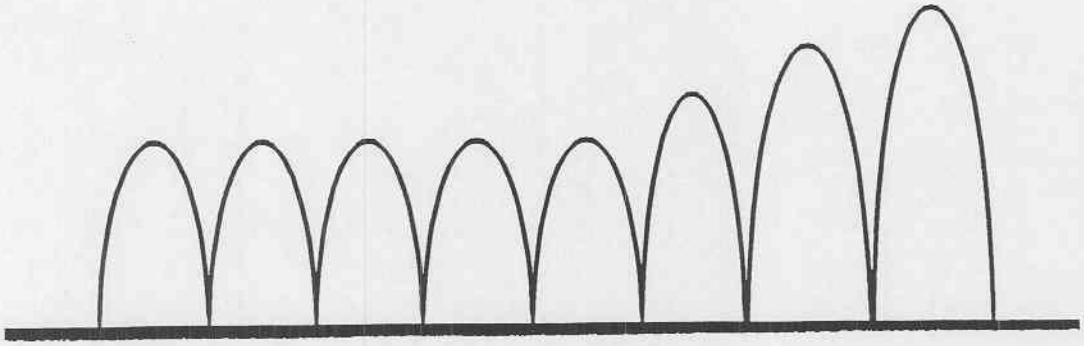
Use **TABLE 2-3,** Filament Calibration Worksheet (or a photocopy) for the following steps. Set the kVp to 78 kVp for all readings. Use a 10 inch FDD to position the kVp meter for all readings in this section.

1. Begin with **[25S]** mA, **<78 kVp>**, and **<2 seconds>**. This has a calculated mAs of 50 mAs. Note that ALL readings in **TABLE 2-3** have a calculated mAs of 50.

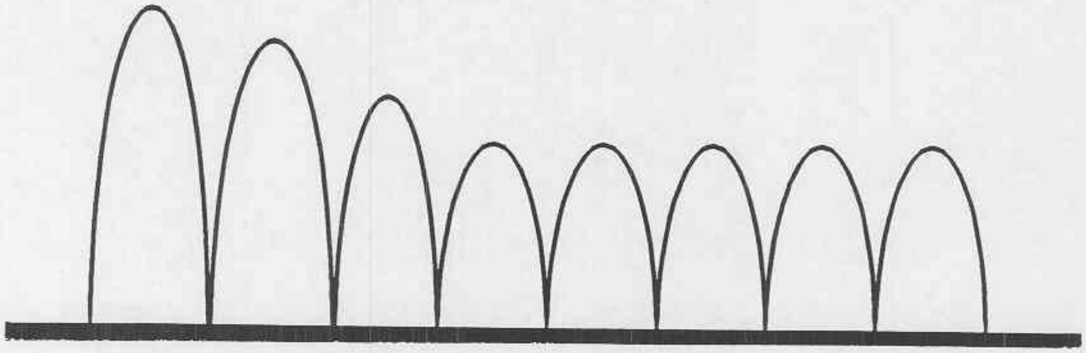
2. Make an exposure and record the mAs and the kVp readings.

The mAs meter reading should be within 5% of the selected value.

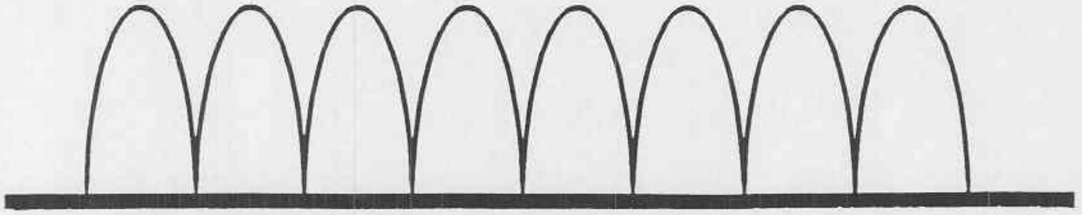
3. Adjust the pots for mA Coarse and mA Fine from **TABLE 2-4,** ±5%, as read on the meters.



TOO MUCH BOOST



TOO LITTLE BOOST



CORRECT BOOST

FIGURE 2-22 FILAMENT BOOST WAVEFORMS

NOTE::
ALL mAs calculate to 50 mAs in the following table.

mA	Time	Reading	Tolerance	Pots
25S	2 sec	kVp	±4	None
		mAs	±2.5	P2 and P12
50S	1 sec	kVp	±4	None
		mAs	±2.5	P3 and P13
100S	1/2 sec	kVp	±4	None
		mAs	±2.5	P4 and P14
100L	1/2 sec	kVp	±4	None
		mAs	±2.5	P5 and P15
150L	1/3 sec	kVp	±4	None
		mAs	±2.5	P6 and P16
200L	1/4 sec	kVp	±4	None
		mAs	±2.5	P7 and P17
300L	1/6 sec	kVp	±4	None
		mAs	±2.5	P8 and P18

Use 78 kVp for all settings. Use a 10" Focal Detector Distance (FDD). All pots are located on the Constant Current Filament Control PCB (6284.234.1009), **FIGURE 2-20**. Pots P2 through P8 adjust "coarse" filament current. Pots P12 through P18 adjust "fine" filament current. Pots P21 through P28 adjust filament boost.

TABLE 2-3 FILAMENT CALIBRATION WORKSHEET

2.2.6 OVER-TABLE FILAMENT CALIBRATION (continued)

4. Adjust the boost pot for the correct waveform as shown in **FIGURE 2-22**.

5. Repeat steps 2, 3, and 4 until all readings are within the specified tolerances. The pot adjustments interact, so it is necessary to adjust and recheck previously adjusted pots to keep in tolerance.

6. Follow the same procedure for all mA stations shown on the Filament Calibration Worksheet, **TABLE 2-3**.

	ADJUSTMENT POTS			
mA STATION	**mA COARSE**	**mA FINE**	**FILAMENT BOOST**	**SPACE CHARGE**
200L SPOT	P1	P11	P21	P31
25S	P2	P12	P22	P32
50S	P3	P13	P23	P33
100S	P4	P14	P24	P34
100L	P5	P15	P25	P35
150L	P6	P16	P26	P36
200L	P7	P17	P27	P37
300L	P8	P18	P28	P38

Pots are located on the Constant Current
Filament Control PCB (6284.234.1009), **FIGURE 2-20**.

TABLE 2-4 FILAMENT ADJUSTMENT POTS

2.2.7 kVp OFFSET & SPACE CHARGE COMPENSATION ☢

Use **TABLE 2-5**, kVp Offset & Space Charge Compensation Calibration Worksheet, for the following steps. Set the kVp to **<50 kVp>** for all readings. Use a **10** inch Focal Detector Distance (FDD) to position the kVp meter for all readings in this section.

1. Begin with **[25S]** mA, **<50 kVp>**, and **<3 seconds>**.

2. Make an exposure and record the mAs and the kVp readings. The meter readings should be within the specified tolerance of the selected values, as read in **TABLE 2-5**. Adjust the appropriate pot as indicated in the table.

3. Repeat step 2 until readings are within the specified tolerances. The pot adjustments interact, so it is necessary to adjust and re-check previously adjusted pots to ensure they remain within tolerance.

4. Follow the same procedure for all mA stations shown on the Worksheet.

2.2.8 kVp SLOPE & SPACE CHARGE CALIBRATION ☢

Use **TABLE 2-6**, kVp Slope and Space Charge Compensation Calibration Worksheet, for the following steps. Set the kVp to **<130 kVp>** for all readings. Use a 36 inch Focal Detector Distance (FDD) to position the kVp meter for all readings in this section.

1. Begin with **[25S]** mA, **<130 kVp>**, and **<1-1/2 seconds>**.

2. Make an exposure and record the mAs and the kVp readings. The meter readings should be within the specified tolerance of the selected values, as outlined in **TABLE 2-6**. Adjust the appropriate pot as indicated in the table.

3. Repeat step 2 until readings are within the specified tolerances. The pot adjustments interact, so it is necessary to adjust and re-check previously adjusted pots so they remain within tolerance.

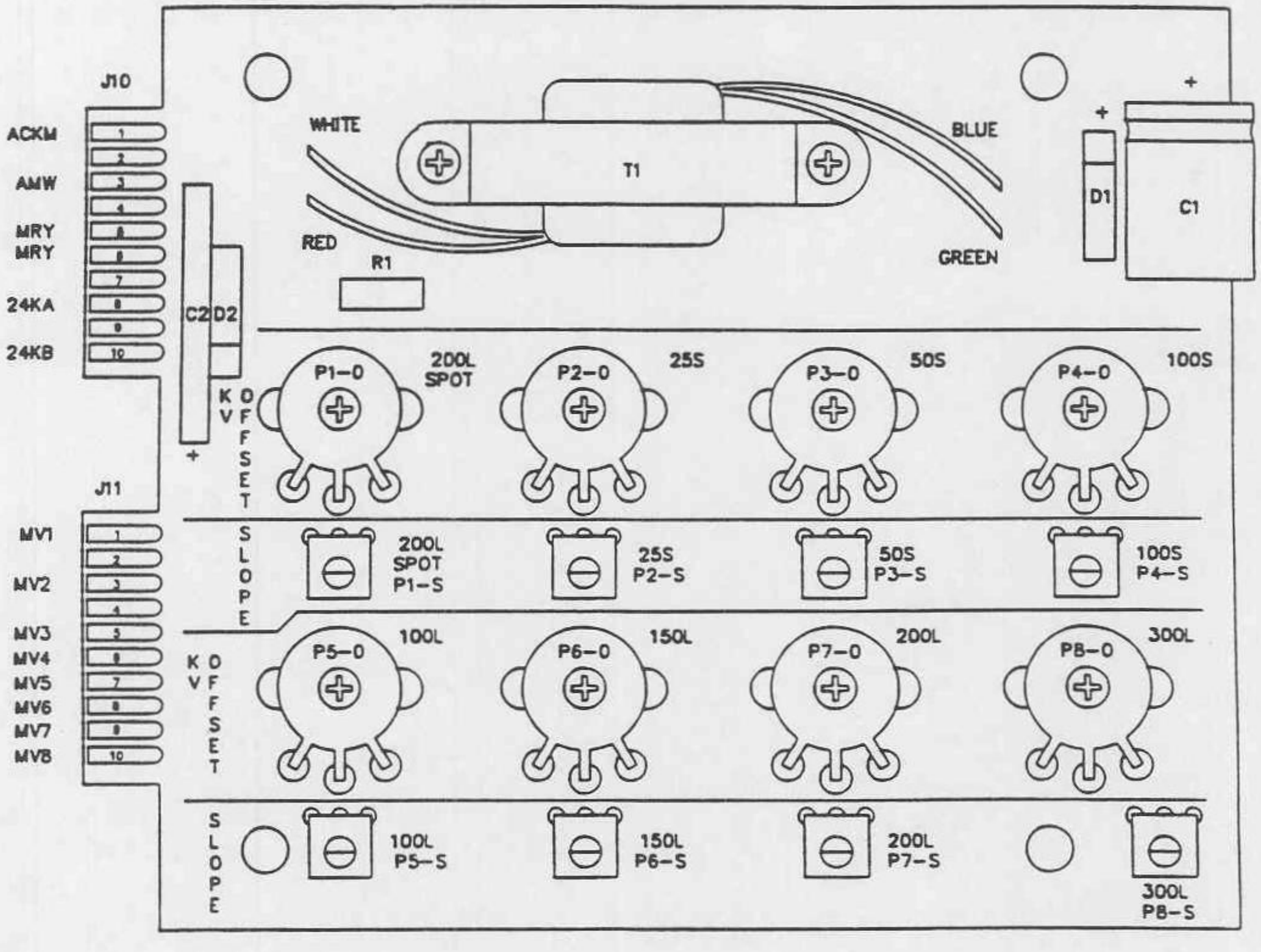
4. Follow the same procedure for all mA stations shown on the worksheet.

kVp OFFSET AND SPACE CHARGE COMPENSATION CALIBRATION WORKSHEET

mA	Time, mAs	Reading	Tolerance	Pots
25S	3 sec	kVp	±3	P2-0
	75 mAs	mAs	±3.8	P32
50S	2 sec	kVp	±3	P3-0
	100 mAs	mAs	±5	P33
100S	1-1/2 sec	kVp	±3	P4-0
	150 mAs	mAs	±7.5	P34
100L	1-1/2 sec	kVp	±3	P5-0
	150 mAs	mAs	±7.5	P35
150L	1 sec	kVp	±3	P6-0
	150 mAs	mAs	±7.5	P36
200L	4/5 sec	kVp	±3	P7-0
	160 mAs	mAs	±8	P37
300L	1/2 sec	kVp	±4	P8-0
	150 mAs	mAs	±7.5	P38

Use 50 kVp for all settings. Use a 10" Focal Detector Distance (FDD). Pots P2-0 through P8-0 ("0" for offset) are located on the kVp Compensation PCB (6284.234.03), **FIGURE 2-23**, and adjust kVp offset compensation. Pots P32 through P38 are located on the Constant Current Filament Control PCB (6284.234.1009, **FIGURE 2-20**, and adjust space charge compensation.

TABLE 2-5 kVp OFFSET & SPACE CHARGE WORKSHEET


J10
ACKM
AMW
MRY
MRY
24KA
24KB
1
2
3
4
5
6
7
8
9
10
WHITE
RED
R1
T1
BLUE
GREEN
+
D1
C1
C2
D2
+
KV OFFSET
SLOPE
J11
MV1
MV2
MV3
MV4
MV5
MV6
MV7
MV8
P1-O
200L SPOT
P2-O
25S
P3-O
50S
P4-O
100S
200L SPOT P1-S
25S P2-S
50S P3-S
100S P4-S
P5-O
100L
P6-O
150L
P7-O
200L
P8-O
300L
100L P5-S
150L P6-S
200L P7-S
300L P8-S

6284.234.03

FIGURE 2-23 kVp COMPENSATION PCB

2.2.9 UNDER-TABLE TUBE CALIBRATION ☢

Use **TABLE 2-7**, Under-Table Calibration Worksheet, for the following steps. Set the kVp as specified, and position the Focal Detector Distance (FDD) as indicated in the table to position the kVp meter.

1. Select [**200L SPOT**] mA, <**78 kVp**>, and <**1/5 second**>.

2. Make an exposure and record the mAs and the kVp readings.

The meter readings should be within the specified tolerance of the selected values, as outlined in TABLE 2-7.

3. Repeat step 2 until readings are within the specified tolerances. The pot adjustments interact, so it is necessary to adjust and re-check previously adjusted pots to ensure that they remain within tolerance.

4. Follow the same procedure for the other two settings shown on the worksheet.

2.2.10 FLUOROSCOPIC kVp CALIBRATION

The Fluoro kVp Meter PCB, 5184.234.09, is located under the fluoro kVp meter, on the inside of the door. See **FIGURE 2-2**, position "E".

For a layout of the PCB, see Chapter 6, Generator, **FIGURE 5-28**.

1. With [**MAINS**] off, connect a digital AC voltmeter across leads AQF and UF on the back of the fluoro kVp meter PCB.

2. Turn [**MAINS**] on. Adjust the fluoro kVp control for 200 volts AC on the digital AC voltmeter.

3. Adjust pot P1 on the Fluoro kVp Meter Shunt PCB for 125 kVp reading on the fluoro kVp meter.

kVp SLOPE COMPENSATION AND SPACE CHARGE COMPENSATION CALIBRATION WORKSHEET

Use 130 kVp for all settings. Use a 36" Focal Detector Distance (FDD). Pots P2-S through P8-S ("S" for slope) are located on the kVp Compensation PCB (6284.234.03), **FIGURE 2-23**, and adjust kVp slope compensation. Pots P32 through P38 are located on the Constant Current Filament Control PCB (6284.234.1009), **FIGURE 2-20**, and adjust space charge compensation.

mA	Time, mAs	Reading	Tolerance	Pots
25S	1-1/2 sec	kVp	±6	P2-S
	37.5 mAs	mAs	±1.9	P32
50S	1 sec	kVp	±6	P3-S
	50 mAs	mAs	±2.5	P33
100S	1/2 sec	kVp	±6	P4-S
	50 mAs	mAs	±2.5	P34
100L	1/2 sec	kVp	±6	P5-S
	50 mAs	mAs	±2.5	P35
150L	1/3 sec	kVp	±6	P6-S
	50 mAs	mAs	±2.5	P36
200L	1/4 sec	kVp	±6	P7-S
	50 mAs	mAs	±2.5	P37
300L	1/6 sec	kVp	±6	P8-S
	50 mAs	mAs	±2.5	P38

TABLE 2-6 kVp SLOPE & SPACE CHARGE WORKSHEET

2.2.11 FLUOROSCOPIC mA CALIBRATION

Turn [**MAINS**] off. Connect the mA meter by removing wire M1 from its terminal strip (**FIGURE 2-1**, front view), and inserting the meter leads between the terminal and the wire.

Adjustments in this section are performed on the Fluoro mA Control PCB, 5184.234.0501 (**FIGURE 2-24**).

Turn [**MAINS**] on.

1. Select fluoro mA position "A" on the fluoro mA select dial. Select 125 kVp on the fluoro kVp meter. Make a fluoro exposure and adjust pot P1 on the Fluoro mA Control PCB for .25 mA on the test equipment display.

2. Select fluoro mA position "B" and 125 kVp on the fluoro kVp meter. Make a fluoro exposure and adjust pot P2 on the Fluoro mA Control PCB for .5 mA on the test equipment display.

3. Select fluoro mA position "C" and 125 kVp on the fluoro kVp meter. Make a fluoro exposure and adjust pot P3 on the Fluoro mA Control PCB for 1.0 mA on the test equipment display.

4. Select fluoro mA position "D" and 125 kVp on the fluoro kVp meter. Make a fluoro exposure.

   The fluoro high level buzzer should sound during exposure.

   Adjust pot P4 on the Fluoro mA Control PCB for 2.25 mA on the test equipment display.

5. Select fluoro mA position "E" and 125 kVp on the fluoro kVp meter. Make a fluoro exposure.

   The fluoro high level buzzer should sound during exposure.

   Adjust pot P5 on the Fluoro mA Control PCB for 4.5 mA on the test equipment display.

Turn [**MAINS**] off.

200L SPOT mAs STATION CALIBRATION WORKSHEET

FILAMENT, kVp SLOPE, OFFSET, AND SPACE CHARGE COMPENSATION WORKSHEET

Use a 10" Focal Detector Distance (FDD) from the top surface of the under-table collimator for all settings.

a. Pots P1, P11, P21, and P31 are located on the Constant Current Filament Control PCB (6284.234.1009), **FIGURE 2-20.**

b. Pots P1 and P11 adjust filament current.

c. P21 adjusts filament boost.

d. Pots P1-O and P1-S are on the kVp Compensation PCB (6284.234.03), **FIGURE 2-23.** They adjust kVp offset and slope.

Time	kVp, mAs	Reading	Tolerance	Pots
1/5 sec	78 kVp	kVp	±4	None
	40 mAs	mAs	±2	P1,P11,P21
1-1/2 sec	60 kVp	kVp	±3	P1-O
	300 mAs	mAs	±15	P31
1/20 sec	130 kVp	kVp	±6	P1-S
	10 mAs	mAs	±5	P31

TABLE 2-7 200L SPOT CALIBRATION WORKSHEET

2.3 CALIBRATION OF THE X-RAY GENERATOR USING A DYNALYZER™

CALIBRATION WITH A DYNALYZER™

Use the following instructions if calibrating the x-ray generator with a Dynalyzer™. If calibration is performed with non-invasive meters, follow the instructions in **Section 2.2**

Each mA station needs to be calibrated for filament control, filament boost, space charge compensation, and kVp compensation. These adjustments are interactive, and need to be performed as a set on each mA station.

X-ray current skews at different kilovoltages, due to the space charge effect. It is necessary to compensate for the space charge effect by increasing the filament level at low kVps and decreasing it at high kVps. This is performed by a series of pot adjustments.

2.3.1 INSTALLATION OF THE DYNALYZER™

Regardless of the test equipment used, **ALWAYS** follow the manufacturer's instructions for their use, even though general instructions are given in this manual.

- **ALL** mA and kVp measurements are to be made as close to the x-ray tube as possible.
- In general, **ALL** kVp measurements are made with both anode and cathode cables connected into the high voltage divider. **ALL** mA measurements are made with only the anode cables connected to the high voltage divider, due to the loading of the filament by the high voltage divider.
- When using a scope to measure kVp, one channel reads anode kVp, and the other channel reads cathode kVp. One channel is inverted. **Both** channels are algebraically added together for total kVp. Connect Channel **1** of the scope to the kVp output of the Dynalyzer™. Connect Channel 2 to the mA output of the Dynalyzer™.
- Liberally coat **ALL** high voltage cable ends with insulating compound (i.e., DOW DC-4) when using with test equipment.

2.3.2 EXPOSURE mAs CALIBRATION

1. Turn **[MAINS]** on. Select **[100L]** mA, **<1/2 second>**, and **<80kVp>**.

2. Press and hold the mAs pushbutton while making an exposure. Observe the mAs meter while holding **[PREPARE]**, **[EXPOSE]**, and **[mAs]** after the exposure ends. It should read 50 mAs, ±5%.

3. If the mAs meter on the control panel drifts up or down, adjust pot P2 (Drift) on the mAs Current Integrator PCB (6284.234.0803), **FIGURE 2-21**.

4. Release all buttons, and press **mAs** only. The mAs meter should read zero. Adjust pot P1 (Zero Adjustment) on the mAs Current Integrator PCB for zero indication.

5. Compare the meter reading on the control to the Dynalyzer™ mAs meter. Adjust pot P3 on the mAs Current Integrator PCB, until the meter on the control panel agrees with the Dynalyzer™.

6. Make another exposure and adjust pot P3 (mAs Meter Adjustment) on the mAs Current Integrator PCB for 50 mAs ±5%.

2.3.3 KVP COMPENSATION

> **NOTE:**
>
> Before proceeding with this section, verify Filament Boost adjustment, following the instructions in **Section 2.2.5**. These instructions require only a storage scope.

kVp compensation calibration verification is performed using **TABLE 2-8.** If a voltmeter is not connected from the previous procedure, turn **[MAINS]** off and connect the voltmeter across terminals AC and AM (located on the back of the major and minor kVp selector switches).

Verify that for **ALL** mA stations, the kVp meter (AK in **FIGURE 2-2**) readings correspond to the appropriate AC voltage between AC and AM.

In **TABLE 2-8**, the first "Adjust" column is for all offset (O) pots, and the second "Adjust" column is for all slope (S) pots. Verify the kVp meter reading against the Dynalyzer™. Adjust the corresponding pot for the appropriate value read by the voltmeter across terminals AC and AM.

1. Turn **[MAINS]** on and select all mA stations, one at a time. Verify that the reading on the kVp meter agrees with the kVp reading on the Dynalyzer™, and that the corresponding value in **TABLE 2-8** is reached ±5%.

   To perform this, set time to **<1/10 second>** and generate an x-ray exposure. Verification must be performed at both kVp settings at each mA station.

> **NOTE:**
>
> If SAFETY RESET prevents performing this procedure, refer to **Section 2.1.9**, Tube Overload Adjustments.
>
> If the mA reading is more than 10% off while performing this procedure, adjust the appropriate coarse mA pot on the Constant Current Filament PCB (see **TABLE 2-6**). This is a preliminary adjustment.

2. If ALL mA stations track within acceptable parameters, remove the voltmeter and proceed to **Section 2.3.4**.

2.3.3 KVP COMPENSATION (continued)

NOTE:

The remainder of the adjustments for kVp Compensation are on pots located on the kVp Compensation PCB (6284.234.03), **FIGURE 2-23**. Location of the kVp Compensation Panel is shown in the front view of **FIGURE 2-1**.

Since the offset (O) and slope (S) pots are interactive for the low and high ends, adjust accordingly. The slope pot should be adjusted for correction at the high end, and the offset pot should be adjusted at the low end.

Calibrate to 2% of the specified reading as a goal, with 5% maximum as tolerance.

3. Turn **[MAINS]** on. Select **[25S]** mA and set the AC-AM voltage corresponding to 70 kVp in **TABLE 2-8**. Adjust P2-O (25S) so the kVp meter reads 70 kVp. Select the AC-AM voltage corresponding to 120 kVp and adjust P2-S (25S) so the kVp meter reads 120 kVp. Confirm settings at 70 kVp and then 120 kVp, readjusting P2-O and P2-S as required.

4. Select the **[50S]** mA station and set the AC-AM voltage corresponding to 60 kVp in **TABLE 2-8**. Adjust P3-0 (50S) so the kVp meter reads 60 kVp. Select the AC-AM voltage corresponding to 120 kVp and adjust P3-S (50S) so the kVp meter reads 120 kVp. Confirm settings at 60 kVp and then at 120 kVp, readjusting P3-O and P3-S as required.

5. Select [100S] mA and set the AC-AM voltage corresponding to 100S in **TABLE 2-8**. Adjust P4-O (100S) so the kVp meter reads 60 kVp. Select the AC-AM voltage corresponding to 120 kVp and adjust P4-S (100S) so the kVp meter reads 120 kVp. Confirm settings at 60 kVp and then at 120 kVp, readjusting P4-O and P4-S as required.

6. Select [100L] mA station and set the AC-AM voltage corresponding to 100L in **TABLE 2-8**. Adjust P5-O (100L) so that the kVp meter reads 60 kVp. Select the AC-AM voltage corresponding to 120 kVp and adjust P5-S (100L) so the kVp meter reads 120 kVp. Confirm settings at 60 kVp and then at 120 kVp, readjusting P5-O and P5-S as required.

2.3.3 KVP COMPENSATION (continued)

7. Select **[150L]** mA and set the AC-AM voltage corresponding to 150L in **TABLE 2-8**. Adjust P6-O (150L) so that the kVp meter reads 60 kVp.

Select the AC-AM voltage corresponding to 120 kVp and adjust P6-S (150L) so the kVp meter reads 120 kVp. Confirm settings at 60 kVp and then at 120 kVp, readjusting P6-O and P6-S as required.

8. Select **[200L]** mA and set the AC-AM voltage corresponding to 200L in **TABLE 2-8**. Adjust P7-O (200L) so that the kVp meter reads 60 kVp.

Select the AC-AM voltage corresponding to 120 kVp and adjust P7-S (200L) so the kVp meter reads 120 kVp. Confirm settings at 60 kVp and at 120 kVp, readjusting P7-O and P7-S as required.

9. Select **[300L]** mA and set the AC-AM voltage corresponding to 300L in **TABLE 2-8**. Adjust P8-O (300L) so that the kVp meter reads 60 kVp (or 50 kVp on 4% line drop only).

Select the AC-AM voltage corresponding to 120 kVp and adjust P8-S (300L) so the kVp meter reads 120 kVp. Confirm settings at 60 (or 50) kVp and at 120 kVp, readjusting P8-O and P8-S as required.

10. Select **[200L SPOT]** mA and set the AC-AM voltage corresponding to 200L SPOT in **TABLE 2-8**. Adjust P1-O (200L SPOT) so that the kVp meter reads 60 kVp.

Select the AC-AM voltage corresponding to 120 kVp and adjust P1-S (200L SPOT) so the kVp meter reads 120 kVp. Confirm settings at 60 kVp and 120 kVp, readjusting P1-O and P1-S as required.

11. Verify that **[25S]** mA kVp meter reading in **TABLE 2-8** are within ± 5% of the Radiographic kVp meter and Dynalyzer™ for the low and high ends (high end is 120 kVp, and low end is 60 kVp).

12. Verify the rest of the mA station AC-AM voltages in **TABLE 2-8** against the kVp meter and Dynalyzer™ for high and low ends.

13. Turn **[MAINS]** off and remove test equipment.

kVp Calibration Settings for 2% Line Drop

mA	AC-AM	kVp	Adjust	AC-AM	kVp	Adjust
200LSPOT	118	60	P1-0	209	120	P1-S
25S	119	70	P2-0	201	120	P2-S
50S	110	60	P3-0	207	120	P3-S
100S	122	60	P4-0	219	120	P4-S
100L	122	60	P5-0	219	120	P5-S
150L	135	60	P6-0	230	120	P6-S
200L	118	60	P7-0	209	120	P7-S
300L	133	60	P8-0	219	120	P8-S

kVp Calibration Settings for 4% Line Drop

mA	AC-AM	kVp	Adjust	AC-AM	kVp	Adjust
200LSPOT	118	60	P1-0	210	120	P1-S
25S	119	70	P2-0	201	120	P2-S
50S	110	60	P3-0	207	120	P3-S
100S	122	60	P4-0	220	120	P4-S
100L	122	60	P5-0	220	120	P5-S
150L	135	60	P6-0	232	120	P6-S
200L	118	60	P7-0	210	120	P7-S
300L	135	50	P8-0	223	120	P8-S

Pots are located on the kVp Compensation PCB,
FIGURE 2-23, 6284.234.03 Page 2-47

TABLE 2-8 kVp COMPENSATION (continued on next page)

kVp Calibration Settings for 6% Line Drop						
mA	AC-AM	kVp	Adjust	AC-AM	kVp	Adjust
200LSPOT	120	60	P1-0	214	120	P1-S
25S	120	70	P2-0	203	120	P2-S
50S	111	60	P3-0	209	120	P3-S
100S	123	60	P4-0	221	120	P4-S
100L	123	60	P5-0	221	120	P5-S
150L	136	60	P6-0	233	120	P6-S
200L	120	60	P7-0	214	120	P7-S
300L	135	60	P8-0	226	120	P8-S

kVp Calibration Settings for 8% Line Drop						
mA	AC-AM	kVp	Adjust	AC-AM	kVp	Adjust
200LSPOT	121	60	P1-0	218	120	P1-S
25S	120	70	P2-0	203	120	P2-S
50S	111	60	P3-0	209	120	P3-S
100S	123	60	P4-0	222	120	P4-S
100L	123	60	P5-0	222	120	P5-S
150L	136	60	P6-0	235	120	P6-S
200L	121	60	P7-0	218	120	P7-S
300L	137	60	P8-0	231	120	P8-S

Pots are located on the kVp Compensation PCB,
FIGURE 2-23, 6284.234.03

TABLE 2-8 KVP COMPENSATION (continued)

2.3.4 mA FILAMENT (OVER-TABLE X-RAY TUBE) ☢

1. Select **<78 kVp>**, and **<1/2 second>**. Verify **ALL** mA stations, one at a time, by making exposures and observing the mA reading on the high voltage test equipment display. The mA should be within 5% of the selected value.

2. Verify that the mA boost waveforms match the waveforms shown in **FIGURE 2-22**. If they are correct, proceed to **SECTION 2.3.5.**

3. **ALL** filament adjustments for the radiographic mA stations are on the Constant Current Filament Control PCB, drawing 6284.234.1009, **FIGURE 2-20.** The PCB is physically located in the main control (**FIGURE 2-1**, front view). The respective adjustment pots are shown in **TABLE 2-4.** Turn [**MAINS**] off.

4. Connect a digital voltmeter across leads XD1 (22J3) and XCC (7J4) on the Constant Current Filament Control PCB.

5. Turn [**MAINS**] on and select [**25S**] mA, **<78 kVp>**, and **<1/4 second>**. Adjust P30 (Space Charge Zero Adjust) on the Constant Current Filament Control PCB until the voltmeter reads zero (0) volts. This is the zero space charge point. Turn [**MAINS**] off.

6. Make sure the collimator blades on the x-ray tube are **fully closed.** Turn [**MAINS**] on. Make an exposure and observe the mA output on the test equipment display.

7. Using pot P2 (mA Coarse) and pot P12 (mA Fine) on the Constant Current Filament Control PCB, adjust for 25 mA on the test equipment display. Adjust the pot P22 (Boost) for a mA waveshape as shown in **FIGURE 2-22.** Adjustment of P22 will affect the mA value so readjust P2 and P12 for proper value.

8. Select [**50S**] mA, and **<78 kVp>**. Make an exposure and observe the mA output on the test equipment display. Adjust pot P3 (mA Coarse) and pot **P13** (mA Fine) on the Constant Current Filament Control PCB for 50 mA on the test equipment display.

2.3.4 mA FILAMENT (OVER-TABLE X-RAY TUBE) (continued)

9. Adjust pot P23 (Boost) on the Constant Current Filament Control PCB for a level waveform as shown in **FIGURE 2-22.** Readjust P3/P13 if necessary for 50 mA on the test equipment display.

10. Select [100S] mA, and **<78 kVp>**. Make an exposure and observe the mA output on the test equipment display. Adjust the pot P4 (mA Coarse) and the pot P14 (mA Fine) for 100 mA on the test equipment display.

11. Adjust pot P24 (Boost) for the mA waveshape as shown in **FIGURE 2-22.** Readjust pot P4 (mA Coarse) and pot P14 (mA Fine) for 100 mA on the test equipment display.

12. Select [100L] mA, and **<78 kVp>**. Make an exposure and observe the mA output on the test equipment display. Adjust pot P5 (mA Coarse) and pot P15 (mA Fine) for 100 mA on the test equipment display.

13. Adjust pot P25 (Boost) for the mA waveshape as shown in **FIGURE 2-22.** Readjust pot P5 (mA Coarse) and pot P15 (mA Fine) for 100 mA on the test equipment display.

14. Select [150L] mA, and **<78 kVp>**. Make an exposure and observe the mA output on the test equipment display. Adjust pot P6 (mA Coarse) and pot P16 (mA Fine) for 150 mA on the test equipment display.

15. Adjust pot P26 (Boost) for the mA waveshape as shown in **FIGURE 2-22.** Readjust pot P6 (mA Coarse) and pot P16 (mA Fine) for 150 mA on the test equipment display.

16. Select [200L] mA, and **<78 kVp>**. Make an exposure and observe the mA output on the test equipment display. Adjust pot P7 (mA Coarse) and pot P17 (mA Fine) for 200 mA on the test equipment display.

2.3.4 mA FILAMENT (OVER-TABLE X-RAY TUBE) (continued) ☢

17. Adjust pot P27 (Boost) for the mA waveshape shown in **FIGURE 2-22.** Readjust pot P7 (mA Coarse) and pot P17 (mA Fine) for 200 mA on the test equipment display.

18. Select [**300L**] mA, and **<78 kVp>**. Make an exposure and observe the mA output on the test equipment display. Adjust pot P8 (mA Coarse) and pot P18 (mA Fine) for 300 mA on the test equipment display.

19. Adjust pot P28 (Boost) for the mA waveshape as shown in **FIGURE 2-22.** Readjust pot P8 (mA Coarse) and pot P18 (mA Fine) for 300 mA on the test equipment display.

2.3.5 SPACE CHARGE COMPENSATION ☢

Check each mA station for compensation by making exposures at 50 kVp and 110 kVp and noting the mA. If a difference in mA exists, the deviation from the selected mA should be equal and in the same direction at these kVps.

If space charge compensation is within tolerance, proceed to Section 2.3.6.

ALL adjustments pots for Space Charge Compensation are located on the Constant Current Filament Control PCB (**FIGURE 2-20**).

Exposures will be made at 50 kVp and 110 kVp and the mA must be adjusted by the respective space charge pot to be as close as possible to the selected mA.

If the mA is not exact at 50 kVp and 110 kVp, compromise between the two by adjusting the space charge pot for the least deviation at these kVps.

Increasing space charge compensation will increase mA at low kVps and decrease mA at high kVps.

2.3.5 SPACE CHARGE COMPENSATION (continued)

1. Select **[25S]** mA, **<50 kVp>**, and **<1/4 second>**. Make an exposure and observe their output on the test equipment display. Adjust the 25S space charge pot P32 for 25 mA.

2. Select **<110 kVp>**, leaving **ALL** other factors the same. Make an exposure and observe the mA output on the test equipment display.

3. Adjust the 25S space charge pot P32 for 25 mA. If a difference in the mA exists between 50 kVp and 110 kVp, adjust for the least deviation.

4. Select **[50S]** mA, **<50 kVp>**, and **<1/4 second>**. Make an exposure and observe the mA output on the test equipment display. Adjust the 50S space charge pot P33 for 50 mA.

5. Select **<110 kVp>**, leaving **ALL** other factors the same. Make an exposure and observe the mA output on the test equipment display.

6. Adjust the 50S space charge pot P33 for 50 mA. If a difference in the mA exists between 50 kVp and 110 kVp, adjust for the least deviation.

7. Select **[100S]** mA, **<50 kVp>**, and **<1/4 second>**. Make an exposure and observe the output on the test equipment. Adjust the 100S space charge pot P34 for 100 mA.

8. Select **<110 kVp>**, leaving **ALL** other factors the same. Make an exposure and observe the mA output on the test equipment display.

9. Adjust the 100S space charge pot P34 for 100 mA. If a difference in the mA exists between 50 kVp and 110 kVp, adjust for the least deviation.

10. Select **[100L]** mA, **<50 kVp>**, and **<1/4 second>**. Make an exposure and observe the mA output on the test equipment display. Adjust the 100L space charge pot P35 for 100 mA.

11. Select **<110 kVp>**, leaving **ALL** other factors the same. Make an exposure and observe the mA output on the test equipment display.

12. Adjust the 100L space charge pot P35 for 100 mA. If a difference in the mA exists between 50 kVp and 110 kVp, adjust for the least deviation.

2.3.5 SPACE CHARGE COMPENSATION (continued)

13. Select [**150L**] mA, **<50 kVp>**, and **<1/4 second>**. Make an exposure and observe the mA output on the test equipment display. Adjust the 150L space charge pot P36 for 150 mA.

14. Select **<110 kVp>**, leaving **ALL** other factors the same. Make an exposure and observe the mA output on the test equipment display.

15. Adjust the 150L space charge pot P36 for 150 mA. If a difference in the mA exists between 50 kVp and 110 kVp, adjust for the least deviation.

16. Select [**200L**] mA, **<50 kVp>**, and **<1/4 second>**. Make an exposure and observe the mA output on the test equipment display. Adjust the 200L space charge pot P37 for 200 mA.

17. Select **<110 kVp>**, leaving **ALL** other factors the same. Make an exposure and observe the mA output on the test equipment display.

18. Adjust the 200L space charge pot P37 for 200 mA. If a difference in the mA exists between 50 kVp and 110 kVp, adjust for the least deviation.

19. Select [**300L**] mA, **<50 kVp>**, and **<1/4 second>**. Make an exposure and observe the mA output on the test equipment display. Adjust the 300L space charge pot P38 for 300 mA.

20. Select **<110 kVp>**, leaving **ALL** other factors the same. Make an exposure and observe the mA output on the test equipment display. Adjust the 300L space charge pot P38 for 300 mA.

21. If a difference in the mA exists between 50 kVp and 110 kVp, adjust for least deviation. Turn [**MAINS**] off and remove test equipment.

2.3.6 UNDER-TABLE TUBE FILAMENT CALIBRATION ☢

Ensure that [**MAINS**] is off. Remove equipment from over-table x-ray tube and install it on the under-table x-ray tube.

Perform warm up procedure on under-table x-ray tube as described in Section 2.1.2.

1. Turn [**MAINS**] **ON.** Select [**200L SPOT**] mA, <**78 kVp**>, and <**1/4 second**>.

2. Make an exposure on the spot film device and read the mA on the test equipment display. The mA should be within 5% of the selected value.

3. Verify the mA Boost waveform as in **FIGURE 2-22. If these requirements are met, go to Section 2.3.7.**

4. With test equipment in place, turn [**MAINS**] on and select [**200L SPOT**] mA, <**78 kVp**>, <**1/4 second**>.

5. Make an exposure using the spot film device [**PREPARE**] and [**EXPOSE**] push buttons. Observe the mA output on the test equipment display.

6. Using pot P1 (mA Coarse) and pot P11 (mA Fine) on the Constant Current Filament Control PCB (6284.234.1009), **FIGURE 2-20**, adjust for 200 mA on the test equipment display.

7. Adjust pot P21 (Boost) for an mA waveshape as shown in **FIGURE 2-22.** Readjust P1 and P11 for 200 mA.

2.3.7 SPACE CHARGE COMPENSATION (UNDER-TABLE X-RAY TUBE) ☢

Make exposures at <**50 kVp**> and <**110 kVp**> at <**1/4 second**>. If a difference in mA exists between 50 kVp and 110 kVp, the deviation from the selected mA should be opposite and equal.

If it is, go to Section 2.3.8.

1. Select [**200L SPOT**] mA, <**50 kVp**>, and <**1/4 second**>. Make an exposure and observe the mA output on the test equipment display.

2.3.7 SPACE CHARGE COMPENSATION (UNDER-TABLE X-RAY TUBE) (continued) ☢

2. Adjust the 200L SPOT space charge pot P31 for 200 mA on the Constant Current Filament PCB (6284.234.1009), **FIGURE 2-20.**

3. Select **<110 kVp>**, leaving **ALL** other factors the same. Make an exposure.

4. Adjust the 200L SPOT space charge pot P31 for 200 mA.

5. If a difference in the mA exists between 50 kVp and 110 kVp, adjust for the least deviation.

2.3.8 SPOT FILM PREHEAT ☢

1. Turn [**MAINS**] off.

2. Remove lead XSU from its terminal (see terminal strip in **FIGURE 2-1**). On the Fluoroscopic Controls section select **<100 kVp>** and **<5 minutes>**.

3. Turn [**MAINS**] **ON.** Make a fluoro exposure and observe the mA readout. It should read less than 0.01 mA.

If it does, go to Section 2.3.9.

4. Select [**200L SPOT**] mA, **<80 kVp>**, and **<1 second>**.

5. On the Fluoroscopic Controls section select **<100 kVp>** and **<5 minutes>**.

6. Activate a fluoro exposure by depressing the footswitch and observe the mA readout.

7. If a reading of higher than 0.01 mA is indicated, adjust the Preheat Resistor, on 5285.234.05 (**FIGURE 2-1**, right side view), for an indication of .01 mA or less.

8. Turn [**MAINS**] off. Reconnect lead XSU, and turn [**MAINS**] on.

2.3.9 FLUOROSCOPIC kVp CALIBRATION

1. On the fluoroscopic controls, select **<100 kVp>** and fluoro mA position **"A"**. Make an exposure and observe the kVp output on the test equipment display. It should agree with the fluoro kVp meter within 2 kVp.

If it does, proceed to Section 2.3.10.

2. With [**MAINS**] off, connect a digital AC voltmeter across leads AQF and UF on the back of the fluoro kVp meter (**FIGURE 2-2**, view "E").

3. Turn [**MAINS**] on. Adjust the fluoro kVp control for 200 volts AC on the digital AC voltmeter.

4. Adjust pot P1 on the Fluoro kVp Meter Shunt PCB, 5184.234.09 (**FIGURE 2-2** view "E") for 125 kVp reading on the fluoro kVp meter.

5. Make a fluoro exposure and observe the actual kVp on the test equipment display. If necessary, readjust pot P1 on the Fluoro kVp Meter Shunt PCB to match the fluoro kVp meter with the test equipment.

2.3.10 FLUOROSCOPIC mA CALIBRATION

1. On the fluoroscopic controls, select **<125 kVp>**. Fluoro mA positions **"A"** and **"E"** should be 0.5 mA and 4.5 mA respectively on the mA readout when a fluoro exposure is made.

2. Use a radiation meter capable of reading 0 to 10 R/Minute to verify fluoro mA positions **"B"**, **"C"**, and **"D"**. Place the paddle of the R meter in the x-ray beam. Make fluoro exposures using these positions.

3. Positions **"B"**, **"C"**, and **"D"** should read 2.25 R/Minute, 4.5 R/Minute, and 7.5 R/Minute respectively. **ALL** readings should be within 5% of these values.

**If they are, calibration of the x-ray generator is complete.
Proceed to SECTION 3.**

4. Fluoro positions **"A"** and **"E"** are adjusted to a predetermined mA factor. Fluoro positions **"B"**, **"C"**, and **"D"** are adjusted for a table top radiation ("R") level.

2.3.10 FLUOROSCOPIC mA CALIBRATION (continued)

5. Select fluoro mA position **"A"**, and **<125 kVp>**.

6. Make a fluoro exposure and adjust pot P1 on the Fluoro mA Control PCB, 5184.234.0501 **(FIGURE 2-24)**, for 0.5 mA on the test equipment display.

7. Place the paddle of a radiation meter in the radiation beam. Select fluoro mA position **"B"** and **<125 kVp>** and make a fluoro exposure.

8. Adjust pot P2 on the Fluoro mA Control PCB for a table top "R" reading of 2.25 R/Minute.

9. Select fluoro position **"C"** and **<125 kVp>**. Make a fluoro exposure.

10. Adjust pot P3 on the Fluoro mA Control PCB for a table top "R" reading of 4.5 R/Minute.

11. Select fluoro position **"D"** and **<125 kVp>** and make a fluoro exposure.

The fluoro high level buzzer should sound during exposure.

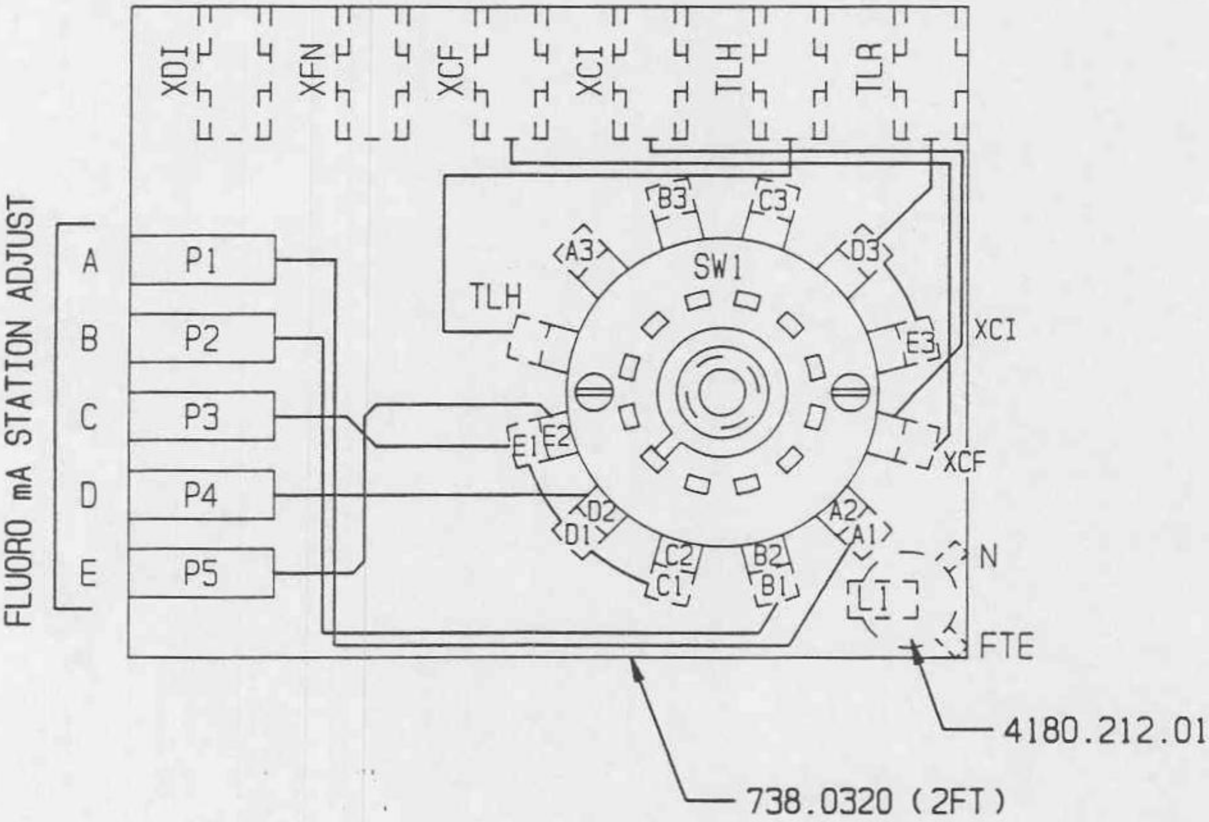
12. Adjust pot P4 on the Fluoro mA Control PCB for a table top "R" reading of 7.5 R/Minute.

13. Select fluoro position **"E"** and **<125 kVp>** and make a fluoro exposure.

The fluoro high level buzzer should sound during exposure.

14. Adjust pot P5 on the Fluoro mA Control PCB for 4.5 mA reading on the test equipment display.

15. Turn **[MAINS]** off and remove ALL test equipment.


FLUORO mA STATION ADJUST
A
B
C
D
E
P1
P2
P3
P4
P5
XDI
XFN
XCF
XCI
TLH
TLR
TLH
SW1
A1
A2
A3
B1
B2
B3
C1
C2
C3
D1
D2
D3
E1
E2
E3
XCI
XCF
N
L1
FTE
4180.212.01
738.0320 (2FT)

5184.234.0501

FIGURE 2-24 FLUORO mA CONTROL PCB

2.4 kVp CALIBRATION (Field Expedient) USING ONLY DIGITAL VOLTMETER

The following calibration procedure does not produce accurate results, as compared to using non-invasive meters, or calibrating with a Dynalyzer™. It is included only as a field expedient alternative.

1. It is essential that the Radiographic kVp meter has been calibrated before proceeding with this section (see **Section 2.1.6**).

2. Determine the percentage line drop from **Section 2.1.4**. Use the appropriate section of **TABLE 2-8**, as determined from the line drop calculation, for kVp compensation calibration. This table consists of four sections, for 2%, 4%, 6%, and 8% line drop.

3. The adjustments for kVp compensation are on pots located on the kVp Compensation PCB (6284.234.03), **FIGURE 2-23**. Location of the PCB is shown in the front view of **FIGURE 2-1**.

4. Turn [**MAINS**] off. Connect a voltmeter across terminals AC and AM, located on the back of the major and minor kVp selector switches.

5. Turn [**MAINS**] on. Select [**25S**] mA. Adjust the major and minor kVp selector switches until the AC-AM voltage corresponding to 120 kVp for the 25S station (±2 volts AC) is read on the voltmeter.

6. Adjust P2-S so that the kVp meter reads 120 kVp, its corresponding value in **TABLE 2-8.** Then set P2-0 for its corresponding value in the table after adjusting the AC-AM voltage.

7 Repeat the procedure for each mA station, using the values in the appropriate section of **TABLE 2-8** for the station being adjusted.

8. If the kVp is within ±5%, it is not necessary to make an adjustment.

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SECTION 3 - SPOT FILM DEVICE CALIBRATION

3.1 SFD CALIBRATION

The spot film device (SFD) is entirely digital with no calibration potentiometers used. Calibration procedures for the collimator interfacing electronics are in **Section 4** of this chapter (the under-table collimator).

The SFD and collimator circuitry are completely calibrated and aligned as a unit before leaving the factory. This calibration is critical to ensure that the SFD operates according to specifications and complies with all applicable regulations.

However, adjustments may be disturbed when the equipment is transported or during installation. Therefore, service personnel must confirm alignment of the SFD, x-ray table and tube as a unit.

As the SFD is mounted in a fixed location relative to the spot film tower, alignment is accomplished automatically when the tower is plumbed and aligned in accordance with the table manufacturer's instructions.

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SECTION 4 CALIBRATION OF THE UNDER-TABLE COLLIMATOR

4.1 VOLTAGE CHECKS

Perform the following voltage checks on the Under-Table Logic PCB, 70-08084, (see **FIGURE 4-1**) with the negative probe lead of the DVM to TP1 (ground).

1. TP3	+5.00 VDC ± 0.01	Adjust R8, if necessary
2. TP6	+10.00 VDC ± 0.05	With switch 3 set to position 8, adjust R46, if necessary.
3. TP6	+10.18 VDC ± 0.05	With switch 3 set to position 9, adjust R60, if necessary.

4.2 CENTERING COLLIMATOR USING FLUOROSCOPY

NOTE:

To perform this adjustment, the table top must be removed. Refer to the Installation Chapter for table top removal.

☢

1. Activate a very low fluoro exposure (i.e., 0.5 mA @ 50 kVp) and adjust the shutter controls to just display the four shutter blades on the fluoro image

    - If the collimator blades are evenly centered,as shown in **FIGURE 4-2**, proceed to **Section 4.3.**

    - If the collimator blades are not evenly centered, determine the direction of movement required.

2. Loosen the four collimator mounting screws, and shift the collimator (**without x-ray**) to center all four shutters on the image.

3. Tighten the four mounting screws.

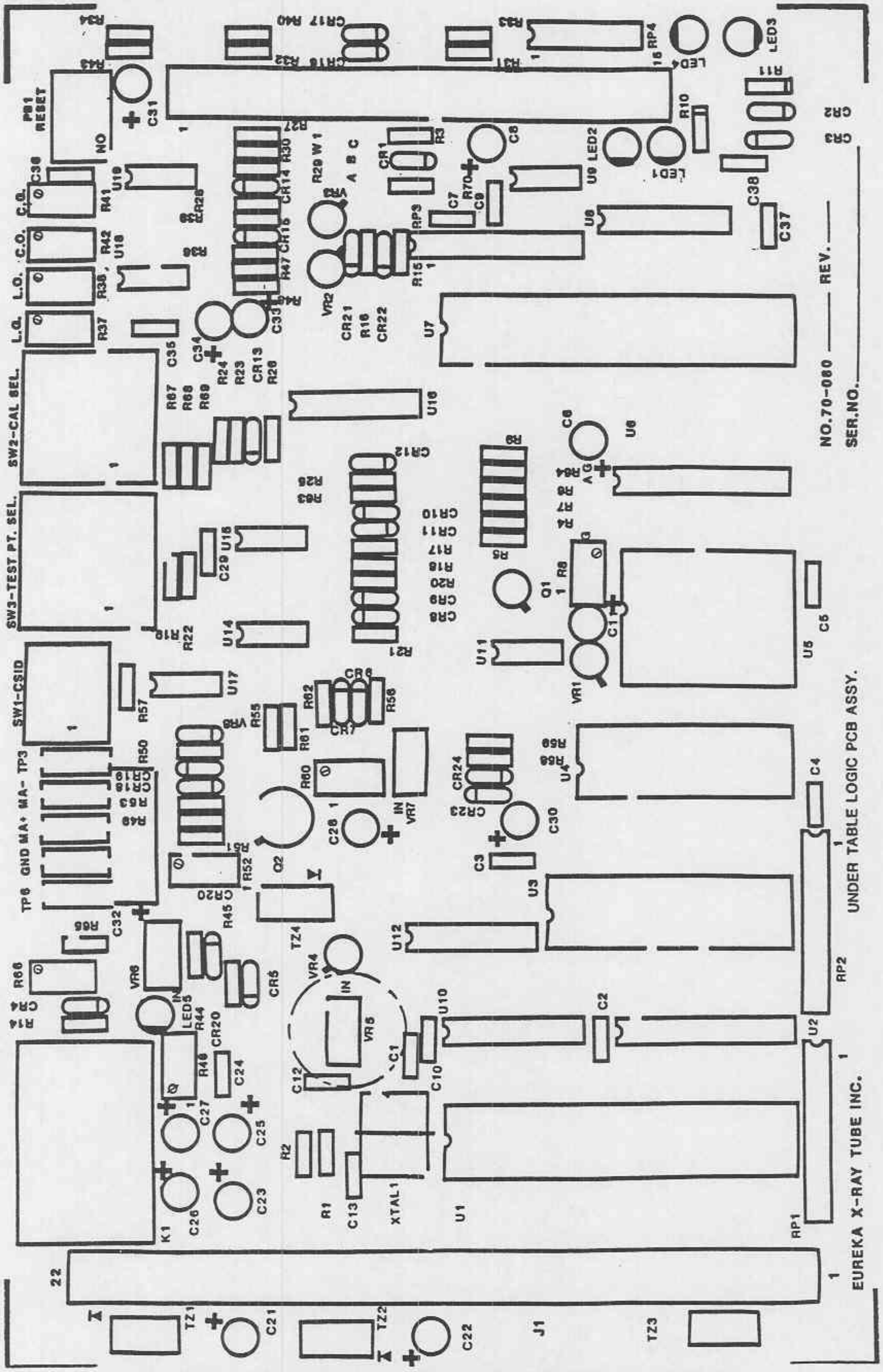
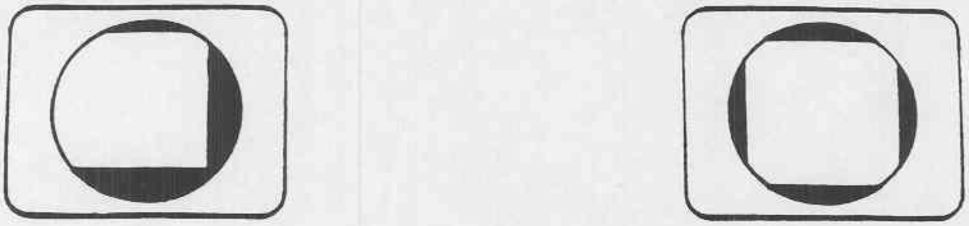

PB1 RESET
NO
SW2-CAL SEL.
SW3-TEST PT. SEL.
SW1-CSID
TP8 GND MA+ MA- TP3
L.O.
C.O.
K1
J1
TZ1
TZ2
TZ3
TZ4
XTAL1
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U14
U15
U16
U17
LED1
LED2
LED3
LED4
LED5
RP1
RP2
RP3
RP4
Q1
Q2
VR1
VR2
VR4
VR5
VR6
VR7
C21
C22
22
1
NO.70-080
SER.NO.
REV.
UNDER TABLE LOGIC PCB ASSY.
EUREKA X-RAY TUBE INC.

FIGURE 4-1 UNDER-TABLE LOGIC PCB, 70-08084



MIS-ADJUSTED

PROPERLY ADJUSTED

FIGURE 4-2 COLLIMATOR BLADE CONFIGURATION

4.3 CONTINUOUS SID ADJUSTMENT

> **NOTE:**
>
> Prior to adjustment, remove any mechanical stops (e.g., myelographic) which would prevent the spot film device from traveling its full vertical movement.

1. Lower the spot film device to its minimum SID.

2. Connect a DC ammeter to TP4 (mA+) and TP5 (mA-) on the Under-Table Logic PCB, 70-08084 (see **FIGURE 4-1**).

3. With **<MAINS> ON**, place the mA CAL switch (SW1-1) on the Under-Table Logic PCB, to the **OFF** (open) position.

4. Adjust R52 (CSID slope), for 7.21 mA.

5. Place the mA CAL switch to the **ON** (closed) position and remove the DC ammeter leads.

6. Set the CAL/MODE switch SW2 to position 9. The word "CALO" followed by the word "SIDI" will be displayed.

7. Determine minimum SID by the following:

   a) Move the spot film device to the rear of the table, and at its lowest position.

   b) Position a film cassette so that it protrudes one inch out of the spot film device.

   c) Record the Table top-to-Image receptor Distance (TID). TID is obtained by measuring from the table top to the middle (thickness) of the extended film cassette.

   TID = ______

   d) Calculate and record SID via the following formula:

   TID + 17" = ______ (SID) min

4.3 CONTINUOUS SID ADJUSTMENT (continued)

8. Adjust R66 (VSID Base Adjust) on the Under-Table Logic PCB, until the value on the display corresponds to the calculated SID.

9. Raise the spot film device to its maximum position and again calculate the SID as in Step 7.

TID = ______;

TID + 17" = _______ (SID)max;

10. The value obtained should correspond to the value indicated on the alphanumeric display. If it is not within ±0.3" of the measured value, slight readjustments to R52 (SID Current) and R66 (VSID Base Adjust) must be made.

Repeat Steps 8 and 9 until accurate tracking is obtained at both maximum and minimum SID.

4.4 SHUTTER OFFSET ADJUSTMENT

NOTE:

To perform this adjustment, the table top must be removed. Refer to the Installation Chapter for table top removal.

CAUTION:

In this procedure the collimator blades are opened and closed manually. Move very carefully to prevent damage to the collimator blades.

1. Move the spot film device to 36" SID.
2. Select **<1-On-1>** format with the AUTO shutter **ON**.
3. ☢ Make a radiographic exposure.
4. Select **<9-On-1>** format with the AUTO shutter **ON**.
5. ☢ Make a radiographic exposure.

4.4 SHUTTER OFFSET ADJUSTMENT (continued)

6. Develop and measure the films.

   - If the **<1-On-1>** exposure measures 9-1/8" (±1/8") in both directions

   AND

   - If the **<9-On-1>** exposure measures 2-1/4" (± 1/4) in both directions, proceed to **Section 4.6.**

7. Remove the aluminum filter cover from the under-table collimator.

8. Set CAL/MODE switch, SW2, to position 7.

   - The word "CALO" followed by the word "VXFC" will be displayed.

   - After two seconds the value of the voltage in A/D units proportional to the position of the cross shutter will be displayed.

9. Place fingers on each side of the cross shutter (the one farthest from the x-ray tube). Close the shutters together slowly and without excessive force.

10. Observe the value on the calibration display and adjust pot R42 (Cross Offset) on the Under-Table Logic PCB, 70-08084 (see **FIGURE 4-1**). Adjust the pot for a reading as close to zero as possible, with a realistic reading of about 1 or 2.

11. Set the CAL/MODE switch SW2 to position 6.

    - The word "VXFL" will be displayed followed by the value of the voltage in A/D units proportional to the position of the longitudinal shutter.

12. Slowly close the longitudinal shutters (those closest to the x-ray tube) together.

13. Adjust pot R38 (Longitudinal Offset) on the calibration display. Adjust the pot for a reading as close to zero as possible, with a realistic reading of about 1 or 2.

4.5 SHUTTER GAIN ADJUSTMENT

NOTE:

For the procedures in this section, longitudinal and cross (transverse) measurements of x-ray film must be defined.

Head-to-toe is in the longitudinal direction and front-to-back is in the cross direction.

CAUTION:

The collimator blades must be opened and closed manually in the following procedure. To prevent damage to the collimator blades, move very carefully.

1. With the Under-Table Logic PCB, 70-08084 (see **FIGURE 4-1**), still in CAL/MODE (SW2-6), adjust the longitudinal and cross shutters to a 2" opening manually.

2. Set the spot film device to a 36" SID.

3. Adjust pot R37 (Longitudinal Gain) for 530 ± 2, and pot R41 (C.G.) for 530 ± 2 on the calibration display.

4. Load an unexposed cassette into the spot film device.

5. Set switch 2 to position 0 (RUN).

6. Select a **<1-On-1>** format and make a radiographic exposure.

7. Develop the film and using a ruler, measure the image.

    - If the exposure is 9-1/8" (± 1/8") in both directions, the shutters are calibrated. Proceed to **Section 4.6**.

    - If neither measurement meets this criteria, both the longitudinal and cross pots must be adjusted. Proceed to Step 8.

    - If only the longitudinal shutter measurement is not within specification, proceed to Steps 8, 9, 12, and 13.

    - If only the cross shutter measurement is not within specification, proceed to Steps 10 through 13.

4.5 SHUTTER GAIN ADJUSTMENT (continued)

8. While pressing and holding the PREP switch, set CAL/MODE switch SW2 to position 6 and release the PREP switch.

9. Adjust pot R37 (Longitudinal Gain) while watching the display to achieve a longitudinal exposure of 9-1/8" (± 1/8"). The following will help in the adjustment:

    - An increase in the value shown on the display reflects a decrease in the exposure size. 6 A/D units equals approximately 0.1".

    - A decrease in the value shown on the display reflects an increase in the exposure size. 6 A/D units equals approximately 0.1".

10. While pressing and holding the PREP switch, set the CAL/MODE switch SW2 to position 7 and release the PREP switch.

11. Adjust pot R41 (Cross Gain) while watching the display to achieve a longitudinal exposure of 9-1/8" (± 1/8). The following will help in the adjustment:

    - An increase in the value shown on the display reflects a decrease in the exposure size. 6 A/D units equals approximately 0.1".

    - A decrease in the value shown on the display reflects an increase in the exposure size. 6 A/D units equals approximately 0.1".

12. Place the CAL/MODE switch SW2 to position 0. The word "RUN" should be displayed.

☢

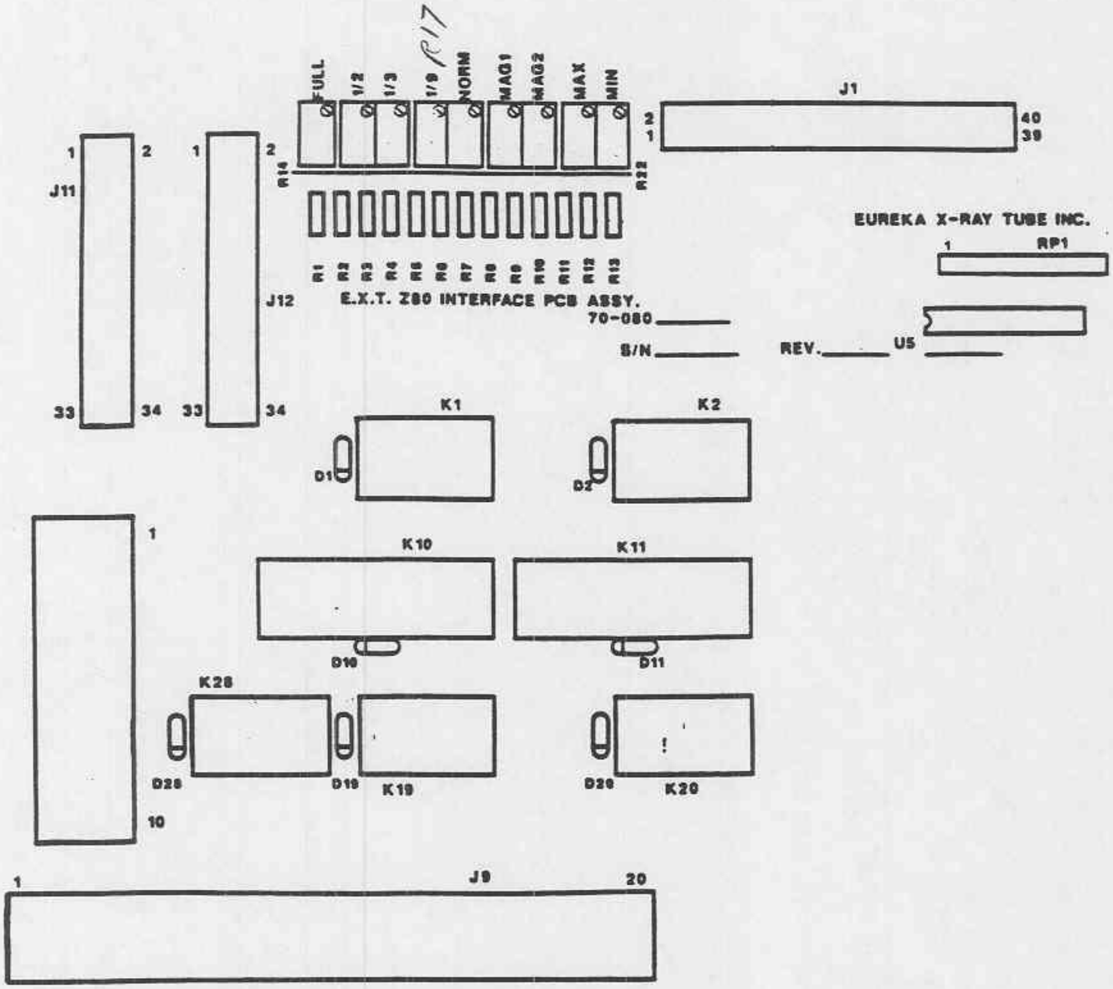
13. Make a radiographic exposure, develop the film, and repeat Steps 7 through 12 until the exposure is 9-1/8" (± 1/8") in both directions.

14. Select <9-On-1> format.

15. Press PREP and move SW2 to position 7.

    - If the calibration display reads approximately 130 A/D units, proceed to step 18.

16. Adjust pot R17 (1/9) on the Z80 Interface PCB, 70-08077 (see **FIGURE 4-3**), clockwise to decrease the value and counterclockwise to increase it.


R17
FULL
1/2
1/3
1/9
NORM
MAG1
MAG2
MAX
MIN
J1
2
1
40
39
R14
R22
1
2
J11
33
34
1
2
J12
33
34
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
E.X.T. Z80 INTERFACE PCB ASSY.
70-080
S/N
REV.
U5
EUREKA X-RAY TUBE INC.
1
RP1
K1
D1
K2
D2
1
K10
D10
K11
D11
K28
D28
D19
K19
D20
K20
10
1
J9
20

70-08077

FIGURE 4-3 Z80 INTERFACE PCB (Located in the Spot Film Device)

4.5 SHUTTER GAIN ADJUSTMENT (continued)

17. Move SW2 to the 0 (RUN) position, then while pressing the PREP pushbutton move SW2 to position 7.

    - If the calibration display reads approximately 130 A/D units proceed to step 18.

    - If this criteria is not met, repeat steps 16 and 17.

☢ 18. Make a radiographic exposure in the **<9-On-1>** format.

19. Develop the film and measure the image.

    - If the image measures 2-1/4" (± 0.20") in each dimension, proceed to step 23.

20. Set SW2 to correspond to the larger of the two dimensions, and manually close those shutters very carefully.

    - Use position 7 for cross dimension

    OR

    - use position 6 for longitudinal dimension.

21. Adjust the appropriate Offset pot to slightly increase the value on the calibration display (approximately 10 A/D units).

    - Use pot R42 for the cross direction (increasing the Offset value decreases the image size)

    OR

    - use pot R38 for the longitudinal direction (increasing the Offset value decreases the image size).

22. If one of the Offset pots is adjusted, repeat steps 4 through 19, until a good square is achieved in both **<1-On-1>** and **<9-On-1>** formats.

23. Replace the aluminum filter cover on the under-table collimator.

4.6 FLUOROSCOPIC IMAGE SIZE ADJUSTMENT

1. Select the fluoro mode on the generator and open the collimator shutter blades to their maximum opening using the shutter controls on the spot film device.

2. Lower the spot film device to its minimum SID.

☢ 3. Press the **X-RAY** switch on the spot film device and observe the fluoroscopic image.

    - The collimator blades should be evenly visible at the edges of the display. If they are NOT, adjust pot R18 (NORM) on the Z80 Interface PCB, 70-08077 (see **FIGURE 4-3)** until they are.

> NOTE:
>
> If unable to obtain a square image on the image tube, repeat the procedures in **Section 4.5.**
>
> Leveling of the image intensifier and the spot film device may also have to be checked. Refer to the Installation Chapter.

☢ 4. Vary the SID of the spot film device while observing the fluoroscopic image.

    - Verify that the image size remains the same as in Step 3 and that all collimator blades are visible.

    - If the image size changes as the SID is changed, refer to **Section 4.3.**

☢ 5. Close the collimator shutter blades to their minimum opening using the shutter controls on the spot film device.

    - Verify that a small, either square or slightly rectangular, image is displayed (less than 2" in any dimension). If it is NOT, adjust pot R22 (MIN) on the Z80 Interface PCB, until the desired image is obtained.

4.7 1-ON-1 (FULL) RADIOGRAPHIC FILM ADJUSTMENT

1. Lower the spot film device to its minimum SID.

2. Select the radiographic mode on the generator.

3. Load an unexposed cassette into the spot film device and place the film in the PARK position.

4. Open the shutter blades to their maximum opening and select the **<1-On-1>** format.

5. Select **AUTO** shutter mode to be ON.

☢ 6. Make a radiographic exposure and develop the film.

7. Measure the exposed area and verify that it is 9-1/8" square (± 1/8").

    - If it does NOT meet this criteria, adjust pot R14 (FULL) on the Z80 Interface PCB, see **FIGURE 4-3**, to increase or decrease the area as required. For an increase in area, decrease A/D units; for a decrease in area, increase A/D units. A change of 6 A/D units equals approximately 0.1".

    - Repeat this procedure until the exposed area is within the specified limits.

4.8 4-ON-1 RADIOGRAPHIC FILM ADJUSTMENT

1. With the spot film device at minimum SID and the radiographic mode selected at the generator, insert an unexposed film cassette and advance to the PARK position.

2. Set the collimator blades to their maximum opening.

☢ 3. Select the <4-On-1> format, **AUTO** shutter mode to be **ON**, and make 4 radiographic exposures.

4.8 4-ON-1 RADIOGRAPHIC FILM ADJUSTMENT (continued)

4. Develop the film and measure the exposed areas.

   - If the dimensions measure 4-9/16" square (± 1/16), with no more than 3/16" gap or overlap between the images, proceed to **Section 4.9.** If they do NOT adjust pot R1 (HALF) on the Z80 Interface PCB, slightly to change the size of the resultant image. If adjustments were made repeat Steps 3 and 4 until the exposed areas are within specification.

4.9 6-ON-1 RADIOGRAPHIC FILM ADJUSTMENT

1. With the spot film device set at the minimum SID, select the radiographic mode on the generator.

2. Load an unexposed cassette into the spot film device and place the film in the **PARK** position.

3. Set the shutter blades to their maximum opening.

4. Select the **<6-On-1>** format, AUTO shutter mode to be **ON**, and make six radiographic exposures on the film.

5. Develop the film and measure the exposed areas.

   - If the dimensions of each exposure are between 4-9/16" (± 1/16) x 3" (± 1/8"), with no more than 3/16" gap or overlap between the images, proceed to **Section 4.10.**

   - If they do NOT, adjust pots R15 (HALF) and R16 (1/3) on the Z80 Interface PCB, to increase or decrease the image size.

   - If adjustment was necessary, repeat Steps 4 and 5 until the exposed areas are within specification.

4.10 9-ON-1 RADIOGRAPHIC FILM ADJUSTMENT

1. With the spot film device set at minimum SID, select the radiographic mode on the generator.

2. Load an unexposed cassette into the spot film device and place the film in the PARK position.

3. Set the shutter blades to their maximum opening.

☢

4. Select the <**9-On-1**> format, AUTO shutter mode to be **ON**, and make 9 exposures on the film.

5. Develop the film and measure the exposed areas.

   - If the dimensions of each exposure are 2-1/4" (± 1/8") square, with no more than 3/16" gap or overlap between the images, proceed to **Section 4.11**.

   - If they do NOT, adjust pot R17 (1/9) on the Z80 Interface PCB, to increase or decrease the image size.

   - If adjustment was necessary, repeat Steps 4 and 5 until the exposed areas are within specification.

4.11 SID TRACKING VERIFICATION

1. Raise the spot film device to its maximum SID.

2. Repeat **Sections 4.7** through **4.10** and verify that the image sizes are within the specified limits for each format.

   - If they are NOT, it may be necessary to recalibrate the SID tracking system. Refer to **Section 4.3** for adjustment.

SECTION 5 - OVER-TABLE COLLIMATOR CALIBRATION

5.1 GENERAL

The following procedure provides the information necessary to properly maintain and calibrate the over-table collimator.

These procedures also form a troubleshooting aid. The external signals used to check the wiring can be verified, and the internal source image distance (SID) and image receptor (IR) signals can be checked for correct Logic PCB and collimator responses.

Although some signals can be internally simulated, external wiring or component defects can prevent proper operation by producing false input signals. For example, an external short circuit to ground on the 40" SID switch will prevent the 40" indicator from coming ON. During any of the following tests, an incorrect indication or operation must be identified and corrected before continuing with the tests.

Do not alter the sequence of these tests as proper results will not be obtained.

5.2 TEST SWITCH CHECK

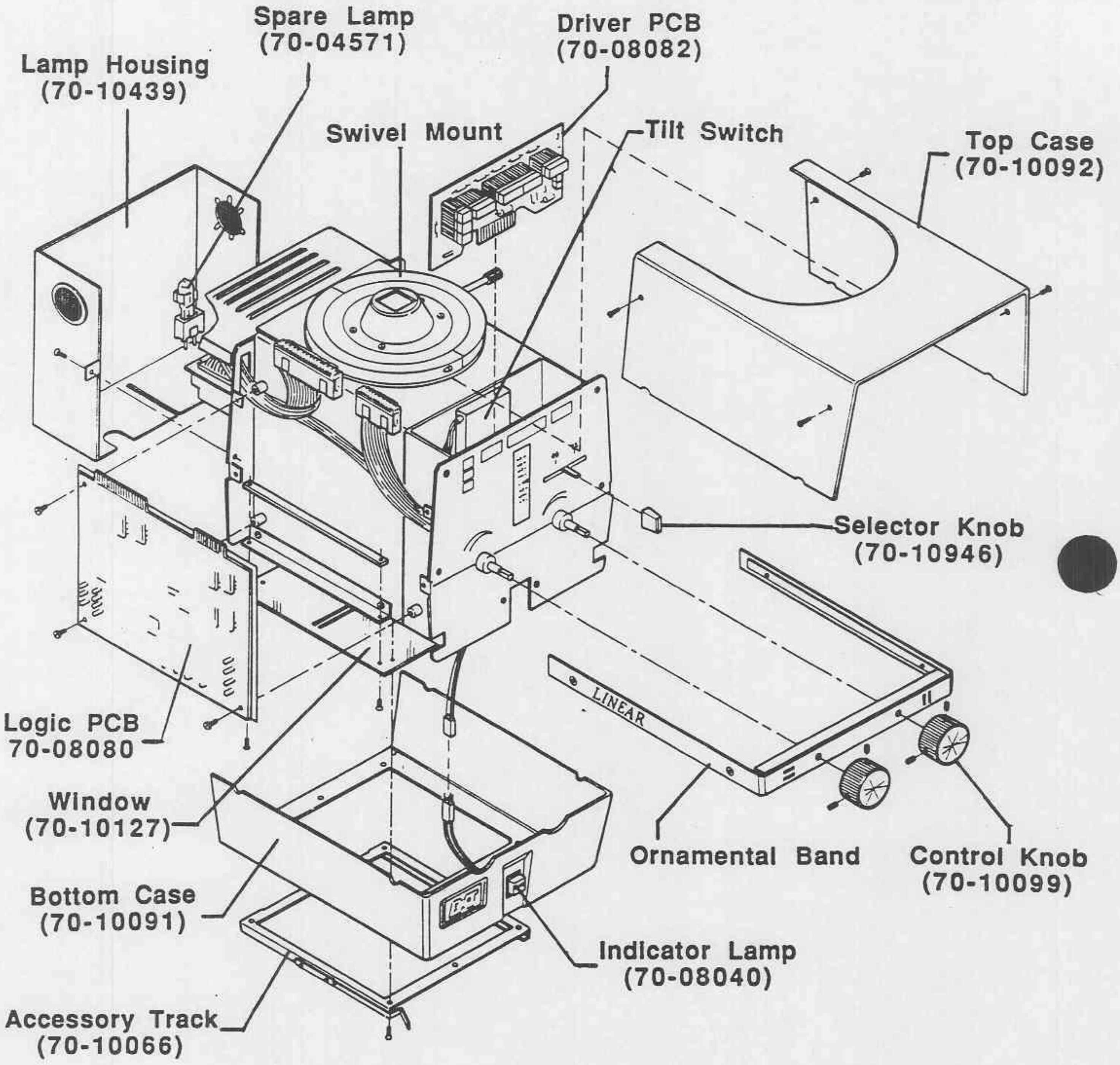
The following sections check the performance of the over-table collimator system switches and the response of the system to specific actions.

5.2.1 COLLIMATOR TILT SWITCH CHECK

1. Remove the collimator bottom cover. See **FIGURE 5-1**.

2. The LEDs and switches are located on the Logic PCB, 70-08080 (see **FIGURE 5-2**). Set the switches on the Logic PCB as follows.

SW2-1	OFF	SW3-1	OFF
SW2-2	OFF	SW3-2	OFF
SW2-3	OFF	SW3-3	OFF
SW2-4	OFF	SW3-4	OFF
SW2-5	OFF	SW3-5	OFF


Spare Lamp
(70-04571)
Driver PCB
(70-08082)
Lamp Housing
(70-10439)
Swivel Mount
Tilt Switch
Top Case
(70-10092)
Selector Knob
(70-10946)
LINEAR
Logic PCB
70-08080
Window
(70-10127)
Ornamental Band
Control Knob
(70-10099)
Bottom Case
(70-10091)
Indicator Lamp
(70-08040)
Accessory Track
(70-10066)

70-08040
FIGURE 5-1 OVER-TABLE COLLIMATOR

5.2.1 COLLIMATOR TILT SWITCH CHECK (continued)

3. Position the tilt switch at 0° horizontal. Angulate the collimator to a 0° beam-down position. Slowly angulate the collimator +20° toward a beam-left position and back to -20° toward a beam-right position.

LED-4 should be **ON** at 0° and remain **ON** until ±11° angulation.

4. Angulate the collimator to a +90° beam-left position and slowly angulate it to 20° down below horizontal (+70° from vertical).

LED-1 should be **ON** at +90° and remain **ON** for 11° below horizontal (+79°).

5. Angulate the collimator to a -90° beam-right position and slowly angulate it to 20° down below horizontal (-70° from vertical).

LED-5 should be **ON** at -90° and remain **ON** for 11° below horizontal (-79°).

5.2.2 TABLE TILT SWITCH CHECK

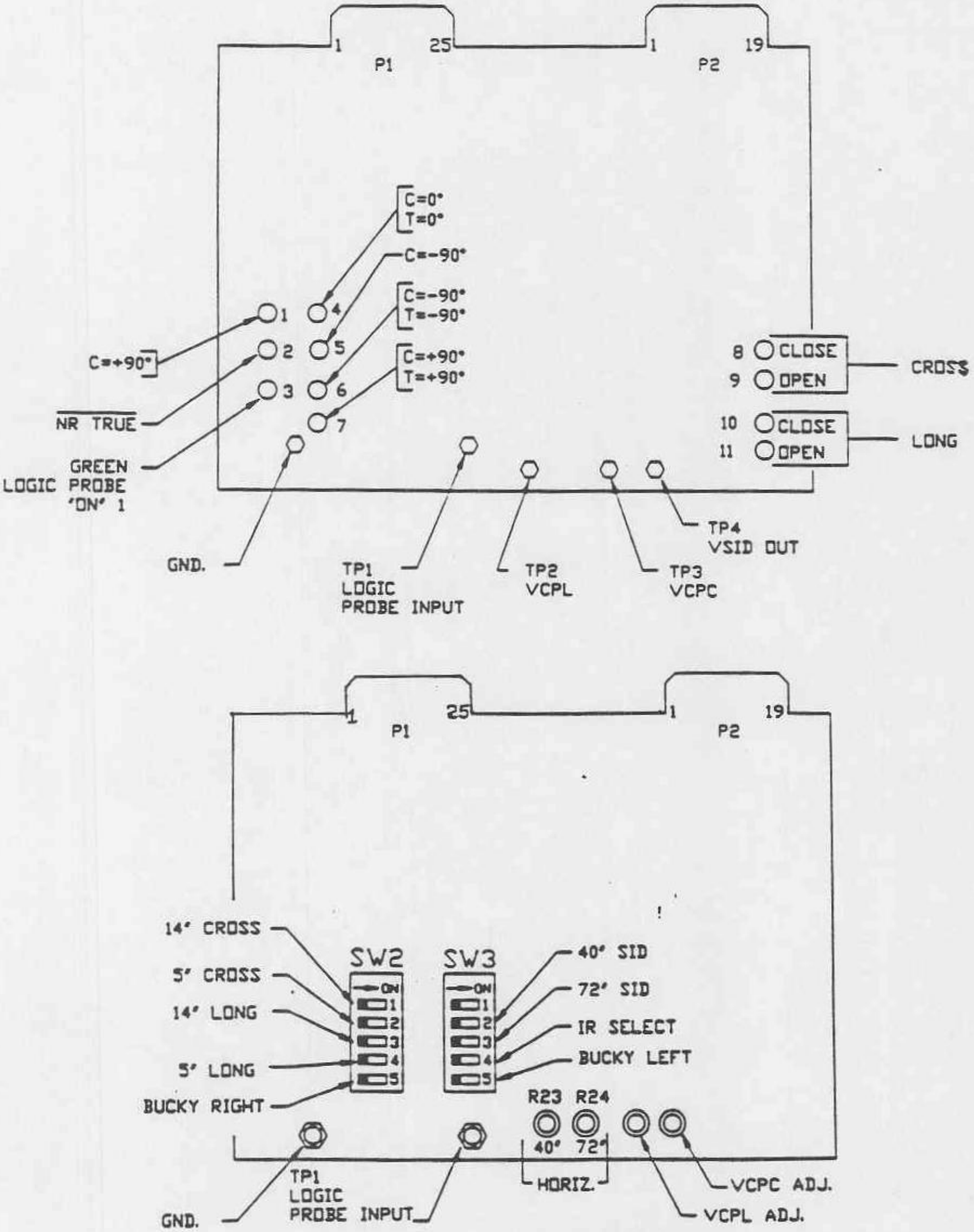
1. Verify that there is no jumper between TS2-5 and TS2-10 on the Logic PCB. Angulate the table to 0° horizontal and slowly tilt it to +20° and then to -20°.

The LEDs and switches are located on the Logic PCB, 70-08080 (see **FIGURE 5-2**).

LED-4 should be **ON** with the table at 0° and remain **ON** until ±11° angulation from horizontal.

2. Position the table at +90° upright and angulate the collimator to a +90° beam-left position. Slowly tilt the table 20° down from the maximum position (+70°).

LED-7 should be **ON** at maximum upright and remain **ON** until the table is angulated down to +79°. LED-1 will also be **ON**.


1
25
P1
1
19
P2
C=0°
T=0°
C=-90°
C=-90°
T=-90°
C=+90°
T=+90°
C=+90°
1
2
3
4
5
6
7
NR TRUE
GREEN
LOGIC PROBE
'ON' 1
8 CLOSE
9 OPEN
CROSS
10 CLOSE
11 OPEN
LONG
GND.
TP1
LOGIC
PROBE INPUT
TP2
VCPL
TP3
VCPC
TP4
VSID OUT
1
25
P1
1
19
P2
14' CROSS
5' CROSS
14' LONG
5' LONG
BUCKY RIGHT
SW2
SW3
ON
1
2
3
4
5
40' SID
72' SID
IR SELECT
BUCKY LEFT
R23
R24
40'
72'
HORIZ.
GND.
TP1
LOGIC
PROBE INPUT
VCPC ADJ.
VCPL ADJ.

SWITCH LOCATIONS

70-08080

FIGURE 5-2 LOGIC PCB

5.2.3 LOGIC AND COLLIMATOR OPERATION CHECK USING INTERNAL SIGNALS

NOTE:

The cassette tray must be removed for the following procedures.

1. Ensure that switches SW2-1 through 4 and SW3-1 through 4 of the Logic PCB are in the **OFF** position. See **FIGURE 5-2.**

2. Angulate the table to 0° horizontal and the collimator to 0° beam-down position.

LED-4 should be **ON.**

3. Measure the distance from the center of the plastic exit window to the center of the light field on the table top. Set this distance to 30-5/8" ±1/16" in order to achieve 40" focal spot to table top distance.

- The **ON** and **MANUAL** indicators on the collimator front panel should be **ON.**

- LED-2 should be **ON.**

4. Set SW2-1 and SW2-3 to the **ON** position to simulate a 14" x 14" cassette. Set SW3-4 to the **ON** position to simulate the insertion of a cassette into the cassette tray.

- LED-2 should switch **OFF.**
- The **MANUAL** indicator should switch **OFF.**
- The **HOLD** indicator should switch **ON.**

5. Set SW3-2 to the **ON** position to simulate a 40" SID switch closure. Move the front panel sliding SID scale knob to the 40" detented position.

- The 40" indicator should switch **ON.**

5.2.3 LOGIC AND COLLIMATOR OPERATION CHECK USING INTERNAL SIGNALS (continued)

- The collimator field size indicators (front panel) should rapidly adjust to about 14" x 14" and stop.

- The **HOLD** indicator should switch **OFF.**

- The **READY** indicators should switch **ON.**

- The light field size on the table top (40" source to table top) should be about 14" x 14". Place the **TEST PATTERN, FIGURE 5-3,** on the table top and tape it into position at the corners.

6. Set SW3-2 on the Logic PCB to the **OFF** position to simulate the opening of the 40" SID switch.

- The 40" indicators should switch **OFF.**

- The **READY** indicators should switch **OFF.**

- The **HOLD** indicator should switch **ON.**

5.2.4 EXTERNAL SID SIGNAL CHECK (HORIZONTAL)

1. Angulate the collimator to 90° with the x-ray beam at the wall mounted cassette holder. Angulate the table to 0° horizontal.

If the cassette holder is on the wall adjacent to the head end of the table the collimator must be at +90° beam-left.

The LEDs and switches are located on the Logic PCB as shown in **FIGURE 5-2.**

- LED-1 should be **ON.**

- Set SW3-5 to the **ON** position and SW2-5 to the **OFF** position to select left-wall operation.

2. Move the collimator horizontally to a 40" SID and slowly move the collimator to a greater and then to a lesser SID.

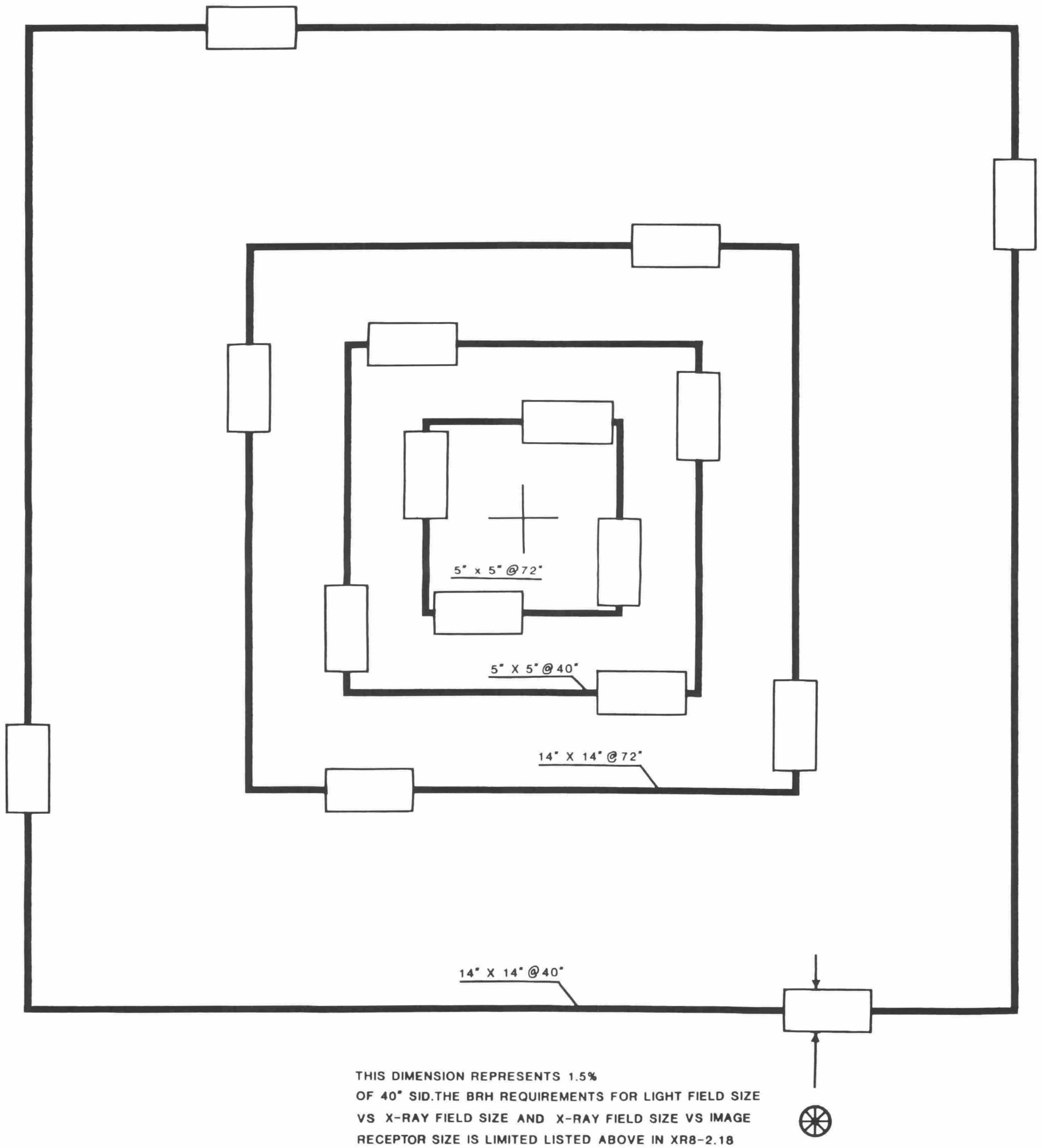
The **40"** indicator on the collimator should be **ON** at a measured 40" SID and should switch **OFF** at a maximum of 40.40" and **OFF** also at a minimum of 39.60" SID.

NOTE: USE THIS TEST PATTERN AT 40" SID

THE MAGNIFICATION FACTOR FOR 72" SID AT 40" SID = 40/72 = .555

THEREFORE THE 5" X 5"@ 72" IS 2.77" X 2.77" AND THE 14" X 14"@ 72" SID IS 7.77

LINEAR II TEST PATTERN
FOR 40" AND 72" SID ADJUSTMENTS



THIS DIMENSION REPRESENTS 1.5%
OF 40" SID.THE BRH REQUIREMENTS FOR LIGHT FIELD SIZE
VS X-RAY FIELD SIZE AND X-RAY FIELD SIZE VS IMAGE
RECEPTOR SIZE IS LIMITED LISTED ABOVE IN XR8-2.18
AND XR8-2.20

FIGURE 5-~~6~~3 TEST PATTERN

SEE DRAWING ON ADJACENT PAGE

FIGURE 5-3 TEST PATTERN

5.2.5 TABLE RECEPTOR SID SIGNAL CHECK

The LEDs are located on the Logic PCB as shown in **FIGURE 5-2.**

1. Angulate the table to a full upright position. Angulate the collimator beam-left to aim the x-ray beam at the upright table cassette tray. LED-7 must be **ON.**

2. Move the collimator horizontally to a 40" SID, and slowly move the collimator to a greater and then to a lesser SID.

The **40"** indicator on the collimator must be **ON** at a measured 40" SID and must switch **OFF** at a maximum of 40.40" and **OFF** again at a minimum of 39.60" SID.

5.2.6 EXTERNAL IR SIGNALS CHECK

The LEDs and switches are located on the Logic PCB as shown in **FIGURE 5-2.**

1. Set the switches as follows:

SW3-1	OFF	SW4-1	OFF
SW3-2	OFF	SW4-2	OFF
SW3-3	OFF	SW4-3	OFF
SW3-4	OFF	SW4-4	OFF
SW2-5	OFF	SW3-5	ON

2. Angulate the collimator 0° beam-down direction with a measured SID of 40" measured to the bucky. For tilting tables, angulate the table 0° horizontal.

- The **MANUAL** indicator should be **ON.**
- LED-2 on the Logic PCB should be **ON.**
- the **40"** indicator should be **ON.**

3. Locate a cassette in the table cassette holder and fully insert the tray into the bucky.

- The **MANUAL** indicator should switch **OFF.**
- The **HOLD** indicator should switch **ON.**

5.2.6 EXTERNAL IR SIGNALS CHECK (continued)

- LED-2 should switch **OFF.**
- The collimator field size indicators (front panel) should rapidly adjust and stop.
- The **HOLD** indicator should switch **OFF.**
- The **READY** indicators should switch **ON.**
- The light field size on the table top should be about the same size as the cassette inserted into the cassette tray. Do not remove the cassette at this time.

4. Tilt the table to a fully upright position. At +79° and without a film cassette in the table bucky, the following should occur.

- LED-2 should switch **ON.**
- The **READY** indicators should switch **OFF.**
- The **MANUAL** indicator should switch **ON.**

5. Angulate the collimator to +90° beam-left position. Insert a film cassette into the cassette tray and fully insert the tray into the table bucky.

- LED-2 should switch **OFF.**
- The **HOLD** indicator should switch **ON.**
- The **MANUAL** indicator should switch **OFF.**

6. Move the collimator to each of the available SIDs to the tilted table (i.e. 40" or 72").

- A SID indicator should switch **ON.**
- The collimator field size indicators (front panel) should rapidly adjust and stop.
- The **HOLD** indicator should switch **OFF.**
- The **READY** indicators should switch **ON.**

5.2.6 EXTERNAL IR SIGNALS CHECK (continued)

- The light field size should be about the same size as the cassette inserted into the table cassette tray.

5.2.7 FINAL TEST SWITCH SETTINGS

The LEDs and switches are located on the Logic PCB as shown in **FIGURE 5-2.**

At the end of this procedure set the switches as follows:

SW2-1	OFF	SW3-1	OFF
SW2-2	OFF	SW3-2	OFF
SW2-3	OFF	SW3-3	OFF
SW2-4	OFF	SW3-4	OFF
SW2-5	OFF	SW3-5	ON

5.3 ADJUSTMENT PROCEDURES

The following adjustment procedures are performed with the collimator in a single fixed position above a test pattern positioned on the table top.

Make the adjustments while observing the light field edges. It is necessary to confirm that the light field accurately represents the x-ray field. By establishing a defined light field and exposing a sheet of film to produce a density of 1.0, the x-ray field can be compared to the light field.

The Performance Standards 1020.30 (b)(22) and (45) define the edges of the light field as the locus of points at which the illumination is one-fourth of the maximum, and the edges of the x-ray field as the locus of points at which the exposure rate is one-fourth of the maximum.

☢ Determine the x-ray field by exposing a sheet of film to a density of 1.0 on the developed image. Observe the point at which the density is just visibly increased above the base fog background of the film.

In a similar manner, determine the light field edges by observing the light field on a white background. Observe the point at which the light field is just visibly increased over the background illumination. By comparing this to the x-ray field (and to the tolerance marks on the pattern), the required adjustments can be made.

5.3.1 VCPL (R25) AND VCPC (R26) VERIFICATION

NOTE:

The over-table collimator has been tested and calibrated during manufacturing. The following procedure will confirm its performance, and re-adjust the SID voltages to match the collimator and the IR (cassette tray) after installation.

Factory set adjustments should **NOT** be altered. They are:

1. R25 (VCPL)
2. R26 (VCPC)

both on the Logic PCB (70-08080).

These pots set the voltages to the collimator feedback pots. The voltages control the tracking of the collimator, closed-to-open, and are very critical.

If (in the unlikely event) they require adjustment, VCPL can be measured at TP-2 and VCPC at TP-3. The factory set values are recorded on the label inside the bottom cover.

R26 controls the voltage to the CROSS feedback pot and is used the balance CROSS to LONG after the correct x-ray field size has been set.

1. Connect a DVM from logic ground to TP-2 (VCPL). Verify that the voltage reading on the DVM is the same as that recorded on the label inside the bottom cover of the collimator.

2. If the voltage reading is not correct, adjust R25 to produce the voltage reading that has been recorded inside the bottom cover of the collimator.

3. Connect a DVM from logic ground to TP-3 (VCPC). Verify that the voltage reading on the DVM is the same as that recorded on the label inside the bottom cover of the collimator

4. If the voltage reading is not correct, adjust R26 to produce the voltage reading that has been recorded inside the bottom cover of the collimator.

5.3.2 LIGHT FIELD/X-RAY CONGRUENCE TEST

1. Place the x-ray source-to-table distance at 40" SID and lock in place.

2. Position a cassette on the table top and accurately center the cassette to the light field. Mark the position of the cassette on the table top.

3. Manually reduce the size of the x-ray field to the next smaller film size.

4. Identify the light field edges and carefully mark them by placing metal markers as shown in **FIGURE 5-4**.

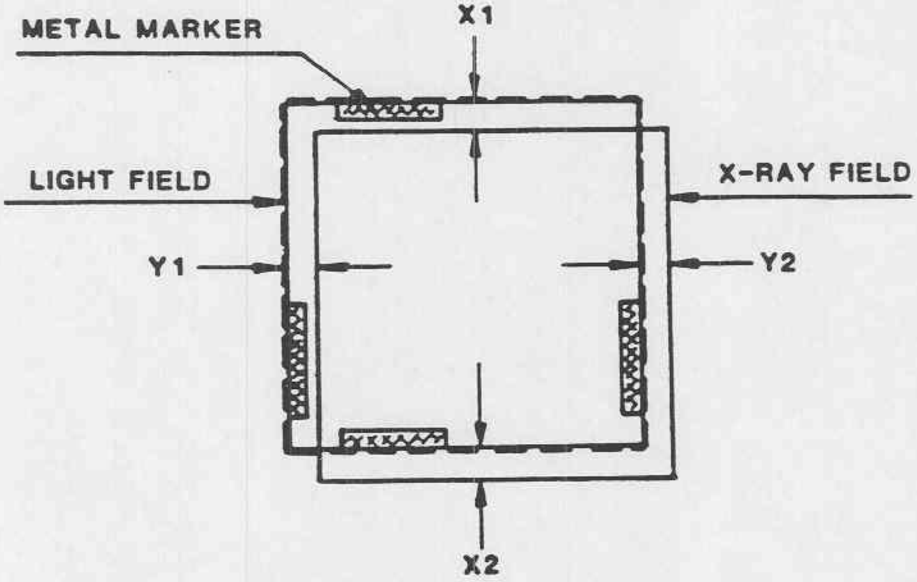


FIGURE 5-4 LIGHT FIELD VS. X-RAY FIELD CONGRUENCY

5.3.2 LIGHT FIELD/X-RAY CONGRUENCE TEST (continued)

5. Expose the film to a density of 1.0 and develop.

6. Carefully identify the x-ray field edges and measure the difference between the x-ray and light field edges.

The sum of the long axis difference (X1+X2) shall not exceed 2% of the SID, and the sum of the cross axis difference shall not exceed 2% of the SID.

If adjustment is required, proceed to steps 7 through 11. If no adjustment is necessary, proceed to **Section 5.3.3**.

7. Remove the lamp cover and bottom cover of the collimator. See **FIGURE 5-1.**

WARNING:

The lamp and heat deflectors may be hot enough to cause severe burns. Do not touch any object in the lamp area with bare skin.

The intensity of the light source is sufficient to cause temporary vision impairment if looked at directly.

Maintain a position that does not allow the filament to be seen when the light source is off.

8. If the developed x-ray image is off-center in the longitudinal direction, loosen the two screws securing the lamp bracket.

9. Use a pair of long-nose pliers to move the bracket slightly until the light field has shifted to a position that is centered to the developed x-ray image in the longitudinal direction. Tighten the two screws securing the lamp bracket.

10. If the developed x-ray image is in error in the cross-table direction, adjust the angle of the mirror using the knurled nuts until the light field has shifted to a position that is centered to the developed x-ray image. See **FIGURE 5-5.**

11. Repeat steps 3 through 6 to confirm the results of the above adjustments.

12. Tighten the lamp bracket screws and replace the lamp housing cover.

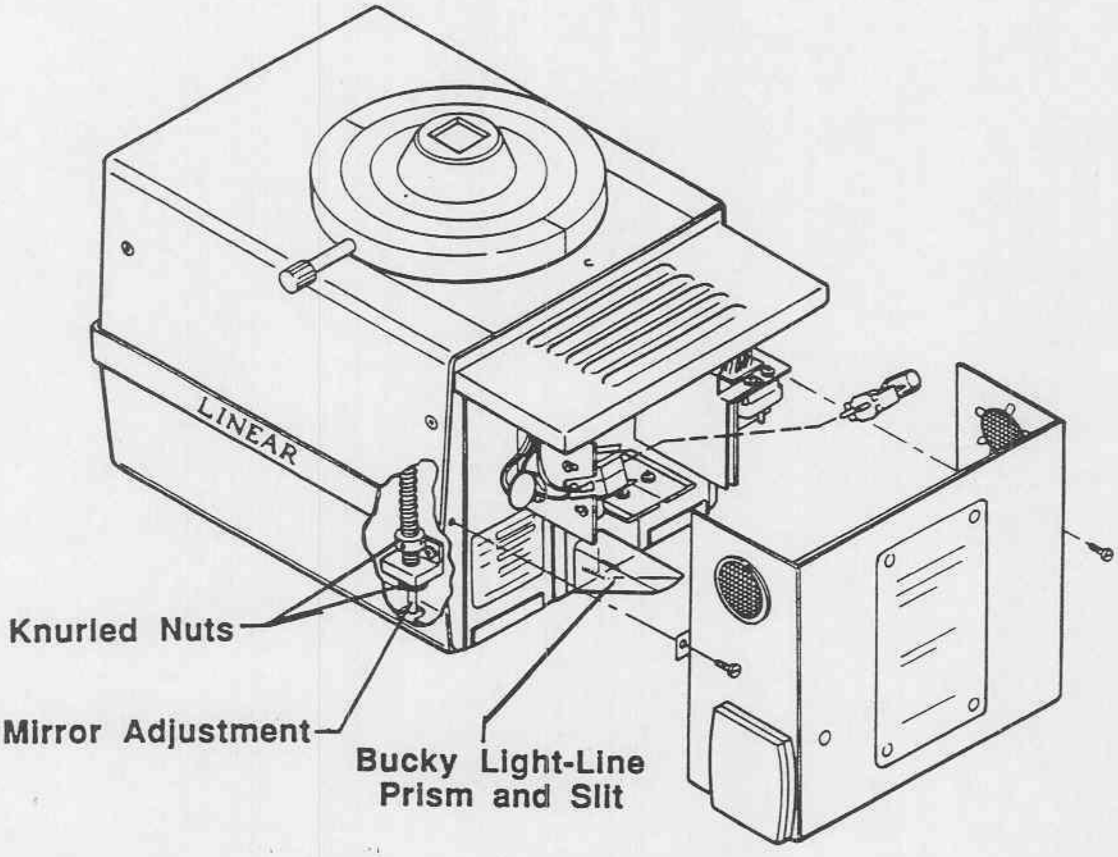

LINEAR
Knurled Nuts
Mirror Adjustment
Bucky Light-Line Prism and Slit

FIGURE 5-5 COLLIMATOR LAMP SECTION

5.3.3 40" SID ADJUSTMENT

The switches are located on the Logic PCB. See **FIGURE 5-2**.

1. Angulate the collimator to 0° beam-down position and the table top to 0° horizontal.

2. Place the TEST PATTERN, **FIGURE 5-3**, on the table top and tape it into position at the corners.

3. Position the collimator at a focal spot distance of 40" ±1/16 by measuring from the center of the exit window to the center of the light field on the table top; this distance should be 30-5/8" ±1/16".

4. If necessary, remove the bottom cover of the collimator to gain access to the program switches on the Logic PCB. See **FIGURE 5-1**.

NOTE:

Be certain there is no cassette in the table bucky.

5. Set SW3-2 to the **ON** position to simulate a 40" HSID.

6. Set SW2-1 and SW2-3 to the **ON** position to simulate a 14" x 14" cassette.

7. Set SW3-4 to the **ON** position to simulate the insertion of the 14" x 14" cassette in the cassette tray.

The light field edges should now be inside the 14" x 14" cassette at the 40" SID tolerance marks on the pattern.

8. If the light field edges are not within the 14" x 14" cassette at the 40" SID tolerance marks, adjust the 40" SID pot R23 a small amount (7.0 VDC nominal on TP-4, IC3-pin1, Logic PCB or TS3-4, Power Supply). Manually turn the collimator knobs to a larger size and release.

The shutters will reset to the new size caused by adjusting R23.

9. Repeat the above procedures until the light field edges are within the 14" x 14" cassette at the 40" SID tolerance marks.

5.3.4 COLLIMATOR FEEDBACK LINEARITY TEST

The following tests will confirm the correct factory settings of the shutter feedback pots by simulating a 14" x 14" cassette size, then simulating a 5" x 5" cassette size. The errors of each of these field sizes must be the same.

EXAMPLE 1
Field size, Step 3.14.1 = 14.5" x 14.5" ; +0.5% error
Field size, Step 3.14.5 = 5.5" x 5.5" ; +0.5% error

CONCLUSION: Errors are consistent, collimator passes linearity test, proceed with Step 3.14.7

EXAMPLE 2
Field size, Step 3.14.1 = 13.7" x 13.7" ; -0.3% error
Field size, Step 3.14.5 = 5.4" x 5.4" ; +0.4% error

CONCLUSION: Errors are inconsistent, collimator fails linearity test, replace the collimator head (P/N 6685.402).

EXAMPLE 3
Field size, Step 3.14.1 = 13" x 14" ; Testing Stopped

CONCLUSION: Errors in only one field size test inconsistent, resulting in a rectangular x-ray field area, collimator fails the test. Replace the collimator head (P/N 6685.402).

The light field should be measured in the CROSS and LONG direction and recorded.
The CROSS size must match the LONG size within ±0.2%.
The switches are located on the Logic PCB. See **FIGURE 5-2.**

1. Set SW3-4 to the **OFF** position (cassette removal).

2. Set SW2-1 and SW2-3 to the **OFF** position, then set SW2-2 and SW2-4 to the **ON** position (exchanging 14" x 14" IR with a 5" x 5" IR).

3. Set SW3-4 to the **ON** position to simulate the insertion of the 5" x 5" cassette in the cassette tray. Allow the system to re-adjust until both **READY** lights illuminate.

The light field should be measured in the CROSS and LONG directions and recorded. The CROSS size must match the LONG size within ±0.20%.

5.3.4 COLLIMATOR FEEDBACK LINEARITY TEST (continued)

4. If they do not match, replace the collimator head.

5. Set SW3-4 to the **ON** position (insertion of a cassette).

6. Reset the test switches as follows:

SW2-1	OFF	SW3-1	OFF
SW2-2	OFF	SW3-2	OFF
SW2-3	OFF	SW3-3	OFF
SW2-4	OFF	SW3-4	OFF
SW2-5	OFF	SW3-5	ON

5.3.5 CASSETTE TRAY ADJUSTMENT

The collimator and cassette tray have been calibrated at 500 ohms for an 11" (12-1/8" outside) cassette. The 11" cassette size represents exactly one-half of the 1K ohm cassette tray pot.

It is suggested that the cassette trays be checked and, if necessary, adjusted. Consult the tray manufacturer's manual for the adjustment procedures. **FIGURE 5-6** outlines the cassette size and corresponding resistance values.

Cassette Size	Ohms Between Pins 1-5 and 4-8
5"	60 Ohms
7	207
8	280
10	427
11	500
12	573
14	720
17	940

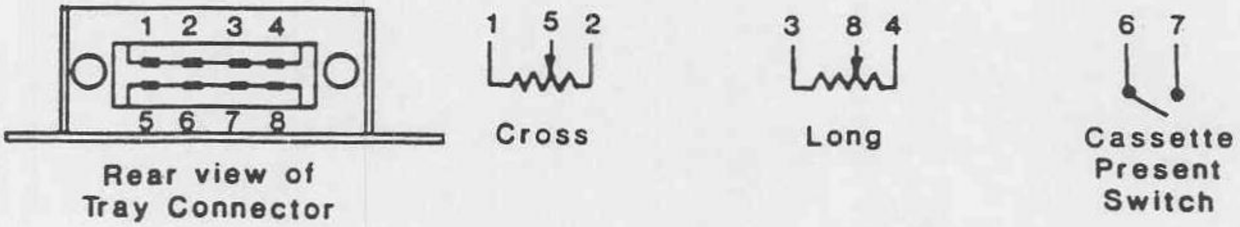


FIGURE 5-6 CASSETTE TRAY POTENTIOMETER WIRING

5.3.6 CROSS-HAIR WINDOW ADJUSTMENT

These procedures are to be performed if the cross-hair shadows are not centered to the light field. If centered, proceed to **Section 5.3.7**.

1. Remove the accessories track and the lower half of the collimator case. See **FIGURE 5-1**.

2. Loosen the screws securing the plastic window.

3. Move the plastic window to align and center the cross-hair pattern to the light field (center lines on the test pattern).

4. Tighten the screws and re-assemble the collimator cover.

5.3.7 BUCKY CENTERING LIGHT-LINE ADJUSTMENT

These procedures are to be performed if the centering light-line is not centered to the correctly adjusted light field.

1. Remove the lamp housing. See **FIGURE 5-1**.

WARNING:

The lamp and heat deflectors may be hot enough to cause severe burns. Do not touch any object in the lamp area with bare skin.

The intensity of the light source is sufficient to cause temporary vision impairment if looked at directly.

Maintain a position that does not allow the filament to be seen when the light source is off.

2. If the centering light-line is off-center to the correctly centered light field, or exhibits a rainbow of colors along one edge, loosen the two screws securing the prism/slit bracket. See **FIGURE 5-4**.

5.3.7 BUCKY CENTERING LIGHT-LINE ADJUSTMENT (continued)

3. Move the bracket to center the light-line with the light field and mark on the handle of the cassette tray.

NOTE:

In order to avoid a rainbow of colors along the edges, or to eliminate these colors, maintain the prism in a position that is centered to the bright light-line observed on the bracket at the base of the prism while adjusting the bracket.

4. Tighten the screws and replace the lamp housing cover.

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SECTION 6 - AUTOMATIC EXPOSURE CONTROL CALIBRATION

6.1 CALIBRATION INSTRUCTIONS

This procedure provides instructions on matching the automatic exposure control (AEC) exactly to the x-ray generator, and to the x-ray absorption characteristics of the screen-film combination used with that x-ray generator.

The kVp Level Adjustment, **Section 6.2**, matches the AEC kVp measuring circuitry to the x-ray generator kVp range.

The Input Amplifier Gain Adjustment, **Section 6.4**, matches the AEC to the screen-film combination near the midpoint of the kVp range.

The kVp Compensation procedure, **Section 6.5**, then completes the matching of the AEC to the screen-film combination, by fine tuning four additional kVp set points on the kVp compensation curve.

The fine tuning is accomplished by making an x-ray exposure, measuring the resultant optical density of the film, adjusting (if necessary) each kVp set point according to a simple formula, and then rechecking with another exposure.

6.1.1 CALIBRATION/TEST SET UP

The collimation and the location of the x-ray tube/arm must remain unchanged throughout the entire calibration procedure.

The x-ray tube/arm must be centered precisely on the center line of the focused grid.

The SID must remain unchanged throughout the calibration procedure and must be within the range of the focused grid.

The phantom must be homogeneous and must completely cover all three fields of the ion chamber. The phantom must sit on the table top. Both the table top and phantom must be level.

The x-ray beam must be collimated to completely cover all three fields of the ion chamber, but the x-ray beam must not be allowed to pass outside of the phantom even near its base.

6.1.1 CALIBRATION/TEST SET UP (continued)

NOTE:

If during calibration it is necessary to make an adjustment on the preamplifier board of the three field ion chamber, the calibration/test set up must be maintained as described above.

To do this, position the x-ray tube/arm and film cassette at the foot (right) end of the table. Reposition the table top so that it will still support the phantom in the proper location, but will also allow access to the preamplifier board.

ADDITIONAL NOTES:

The AEC is calibrated for a particular screen/film combination. A change in the screen/film combination will require the recalibration of the system.

Before calibrating the AEC, the film processor must be in stable operating condition. A change in the film processor (i.e. a change in the operating temperature, replenishment of the processing chemicals, or even a change from one processor to another) during the calibration of the AEC could give results that appear to be inconsistencies in the operation of the AEC.

For all steps in this chapter, **TABLE 6-1** provides information on the necessary schematics and assembly drawings for the printed circuit boards (PCBs) requiring adjustment. The pertinent drawings are located in **CHAPTER 13, Section 7.**

Reference **CHAPTER 13, FIGURE 7-19** for the overall interconnection diagram for the system.

ALL FIGURE NUMBERS REFER TO CHAPTER 13, SECTION 7.

PCB PART NUMBER	SCHEMATIC FIGURE	ASSEMBLY FIGURE	PARTS LIST TABLE
60899B	7-1	7-9	7-1
60900F	7-2	7-10	7-2
60907F	7-3	7-11	7-3
60916C	7-4	7-12	7-4
60917C	7-7	7-13	7-6
60932C	-	7-16	-
60940D	7-8	7-14	7-7
60905D	-	7-17	-
61017C	7-5	7-15	7-5
61061A	-	7-18	-
74074A	-	7-19	-

TABLE 6-1 PCB DRAWING REFERENCE

6.2 kVp LEVEL ADJUSTMENT

This procedure matches the AEC kVp selection circuitry to the actual kVp output levels of the x-ray generator.

Refer to **FIGURE 6-1** for adjustment component locations.

1. Turn x-ray generator on.

   Turn AEC on.
   Select Normal density.
   Switch on 60907 SW3 to enable the LEDs (kVp level indicators).

2. Select 100kVp.

   Adjust 60907 R97 so that LED 60907 L3 just goes out and LED 60907 L4 just comes on.

3. Select 125kVp.

   Adjust 60907 R95 so that LED 60907 L4 just goes out and LED 60907 L5 just comes on.

4. Select 50kVp.

   Adjust 60907 R76 so that LED 60907 L1 just goes out and LED 60907 L2 just comes on.

5. Turn OFF 60907 SW3.

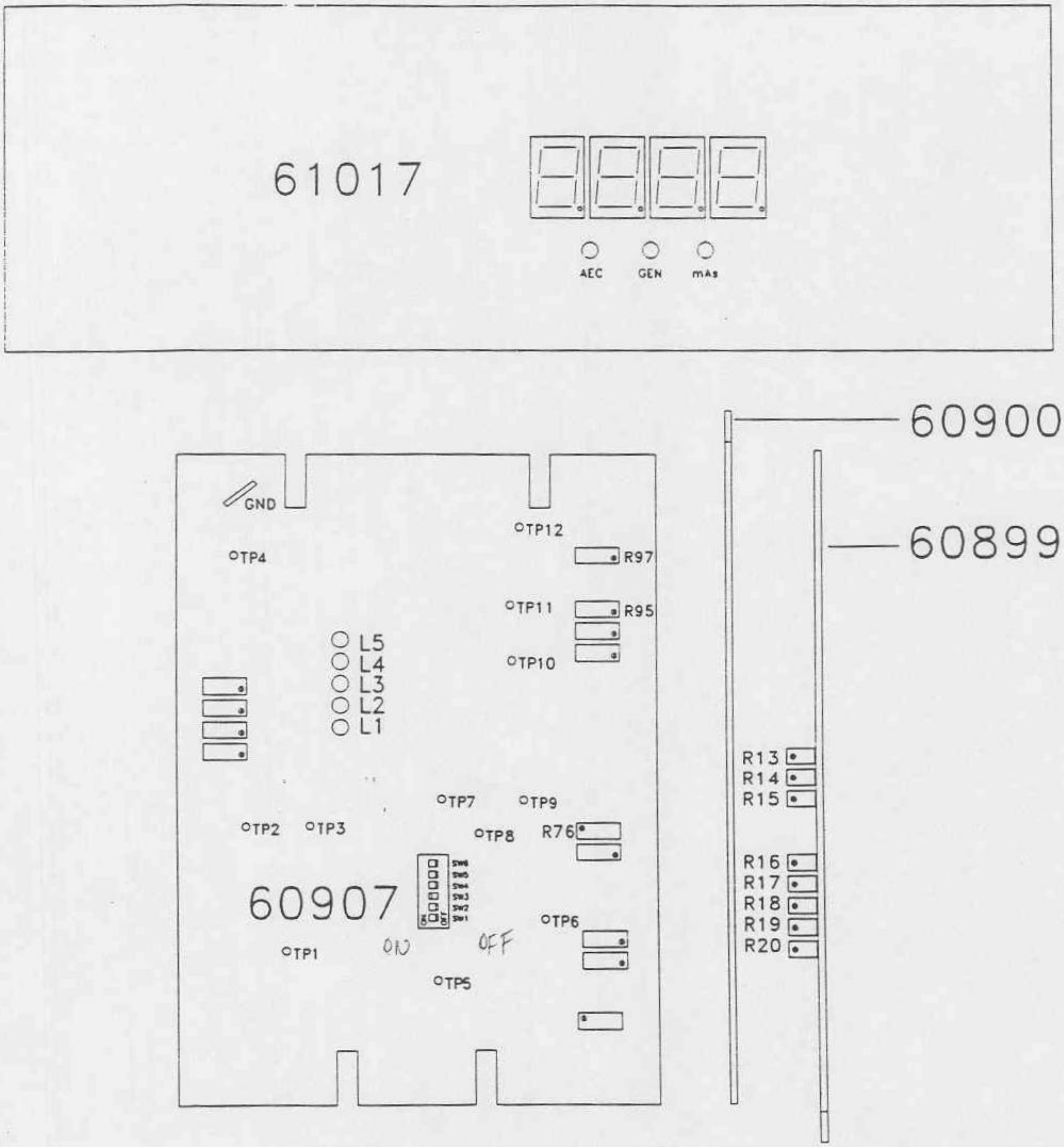

61017
AEC
GEN
mAs
60900
60899
GND
TP4
TP12
R97
TP11
R95
TP10
L5
L4
L3
L2
L1
TP7
TP9
TP2
TP3
TP8
R76
60907
SW6
SW5
SW4
SW3
SW2
SW1
TP6
TP1
ON
OFF
TP5
R13
R14
R15
R16
R17
R18
R19
R20

FIGURE 6-1 ADJUSTMENT COMPONENT LOCATION

6.3 FIELD MATCHING

The output of the individual fields of a three-field ion chamber is calibrated at the factory. It may, however, be necessary to fine tune this adjustment in the field.

It is important that field matching be done based on the optical density (OD) of actual exposures rather than on mAs readings because of the effects of grids, anode-heel effects and back scatter. Therefore, it will be necessary to make exposures, process films, and measure optical densities in order to precisely match the three fields.

In this procedure, x-ray exposures will be required.

Refer to **FIGURE 6-2** for preamplifier field gain adjustment locations.

1. Set the x-ray generator at 100 kVp, 100 mA large focal spot and 5 second backup.
    Select Density N (Normal).
    Select Center Field alone.

2. Position the phantom (10 inches of water or equivalent) as described in **Section 6.1.1**.

3. Place a cassette loaded with an unexposed sheet of film in the cassette holder. Make an x-ray exposure. Record the mAs reading on the AEC 61017 display board.

4. Develop the film. Measure and record the average OD near the center of the exposure. Mark this "Film Center".

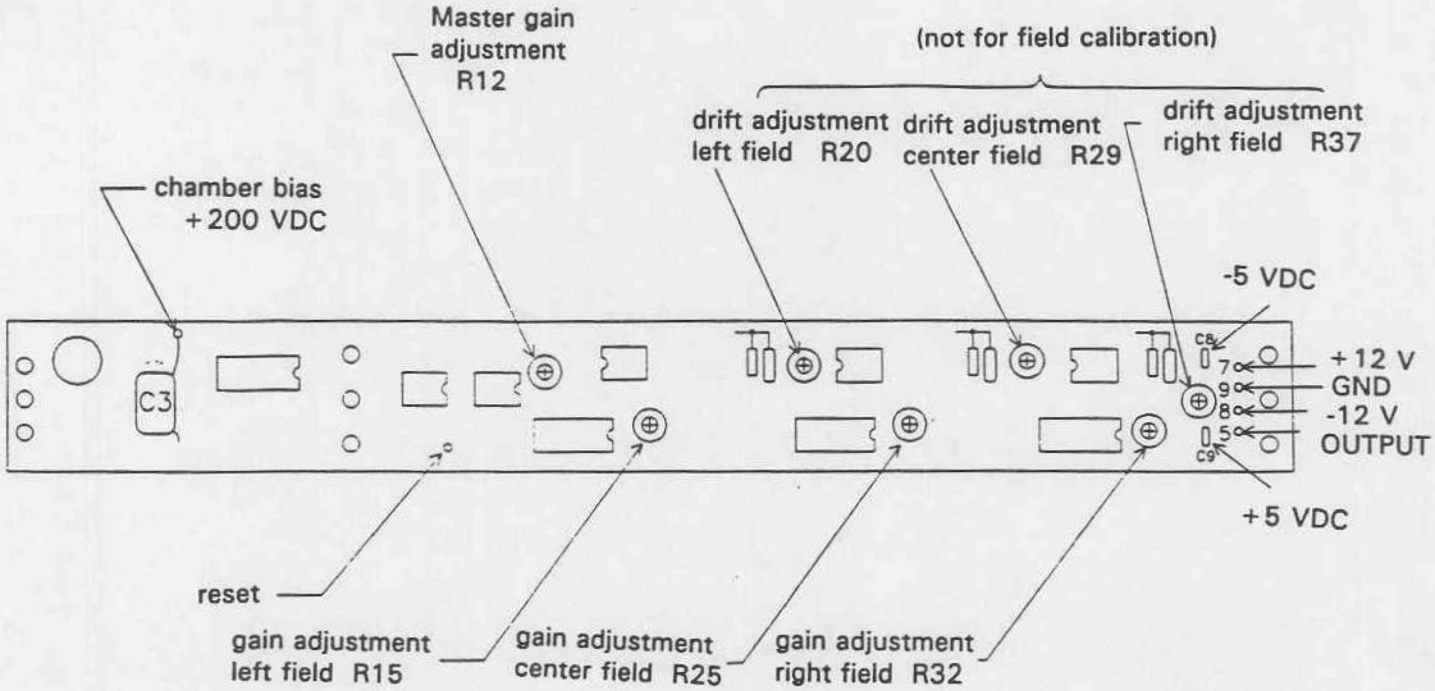
5. Select Left Field alone and repeat Steps 3 through 4. Mark this film "LEFT".

6. Select Right Field alone and repeat Steps 3 through 4. Mark this film "RIGHT".

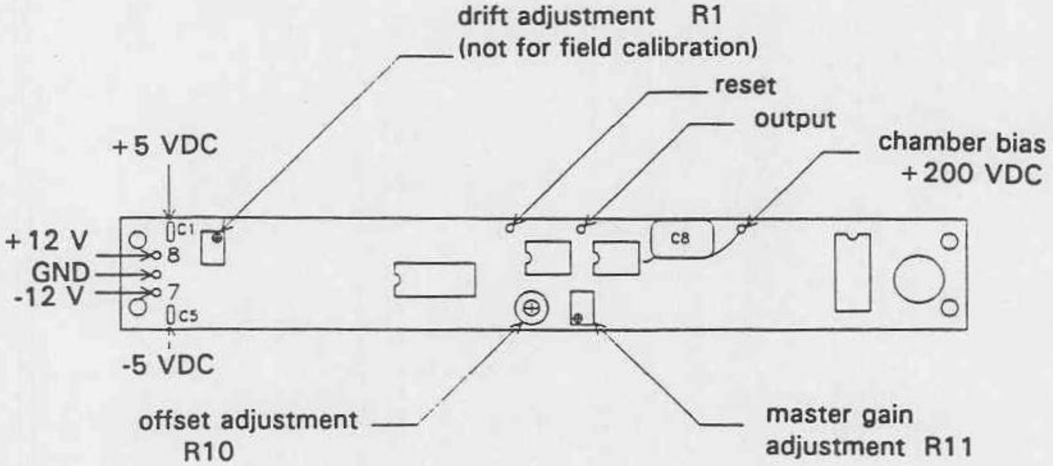
7. Compare the optical densities of the films for the three different fields.

If the optical densities of the three films are within 10% of each other, proceed to **Section 6.5**.

If the optical densities of the three films are not within 10% of each other then make adjustments to the appropriate field gain adjustment on the 60917 Preamplifier board and repeat Steps 3 through 7 as needed.


Master gain adjustment R12
(not for field calibration)
drift adjustment left field R20
drift adjustment center field R29
drift adjustment right field R37
chamber bias +200 VDC
-5 VDC
C3
C8
C9
7
9
8
5
+12 V
GND
-12 V
OUTPUT
+5 VDC
reset
gain adjustment left field R15
gain adjustment center field R25
gain adjustment right field R32

PREAMPLIFIER BOARD 60917


drift adjustment R1
(not for field calibration)
reset
output
chamber bias +200 VDC
+5 VDC
C1
+12 V
GND
-12 V
8
7
C5
C8
-5 VDC
offset adjustment R10
master gain adjustment R11

PREAMPLIFIER BOARD 60940

FIGURE 6-2 PREAMPLIFIER ADJUSTMENT COMPONENT LOCATIONS

6.4 INPUT AMPLIFIER GAIN ADJUSTMENT

☢ In this procedure, x-ray exposures will be required.

Refer to **Section 6.1.1** for calibration/test set-up.

Refer to **FIGURE 6-1** for input amplifier gain adjustment location.

1. Set the x-ray generator at 100kVp, 100mA large focal spot and 5 second backup.

Select Density N (Normal).
Select Center Field alone.

2. Position the phantom (10 inches of water or equivalent) as described in **Section 6.1.1**.

☢ 3. Place a cassette with an unexposed sheet of film in the cassette holder. Make an x-ray exposure. Record the mAs reading on the 61017 display board.

4. Develop the film and measure and record the average OD near the center of the exposure.

5. If the OD is 1.20 ± 0.15, proceed to **Section 6.5**.

If the OD is not 1.20 ± 0.15, continue with Step 6.

6. Determine an approximate value of mAs to correspond to OD = 1.20 by using the following equation:

$$\text{New mAs} = \frac{1.20}{\text{OD (from Step 4)}} \times \text{Old mAs (from Step 3)}$$

☢ 7. Repeatedly make exposures with the loaded film cassette until adjustment of the input amplifier gain 60899 R14 produces the mAs reading calculated in Step 6. Repeat Steps 3 through 5.

If there is insufficient gain adjustment at 60899 R14, then it may be necessary to adjust the preamplifier master gain and repeat Steps 3 through 5. Refer to **FIGURE 6-2** for preamplifier master gain adjustment location.

6.5 kVp COMPENSATION

This procedure requires the prior calibration of the input amplifier gain as given in **Section 6.4.**

☢ In this procedure, x-ray exposures will be required.

Refer to **Section 6.1.1** for calibration/test set-up.

Refer to **FIGURE 6-1** for adjustment component locations.

1. Select Density N (Normal).
   Select Center Field alone.

2. Select the x-ray generator for 100mA large focal spot and 5 second backup.

3. Select the x-ray generator kVp settings and a corresponding phantom thickness in the order listed in **TABLE 6-2.**

4. Place a loaded cassette in the cassette holder.

5. Measure the Compensation Reference Voltage (CRV) for the selected kVp at 60907 TP1.

☢

6. Make an x-ray exposure at the selected kVp with a loaded film cassette.

7. Develop the film and measure the average OD near the center of the exposure.

If the OD is 1.20 ± 0.15, record the CRV in **TABLE 6-2** for future reference and proceed to Step 10.

If the OD is not 1.20 ± 0.15, continue with Step 8.

6.5 kVp COMPENSATION (continued)

8. Use the following equation to calculate a new CRV setting to obtain the approximate desired OD.

$$\text{New CRV} = \frac{1.20}{\text{OD (from Step 7)}} \times \text{Old CRV (from Step 7)}$$

NOTE:

If the exposure required to reach the desired OD exceeds the mAs limit of the AEC or x-ray generator, then the phantom thickness must be adjusted to allow the proper exposure.

9. Adjust the CRV at 60907 TP1 for the selected kVp using the potentiometer on PCB 60899 as indicated in **TABLE 6-1**, to give the new CRV which was calculated in Step 8. Repeat Step 6 and Step 7.

10. Repeat Steps 3 through 7 for all kVp settings listed in **TABLE 6-1** to obtain films with Optical Densities of 1.20 ± 0.15.

X-RAY GENERATOR kVp SETTING	PHANTOM THICKNESS IN INCHES	CRV ADJUSTMENT POT ON PCB 60899	FINAL CRV SETTINGS 60907 TP1
125	12	R19	
150	12	R20	
75	7	R17	
50	5	R16	

TABLE 6-2 kVp COMPENSATION SETTINGS

6.6 SPOT FILM ION CHAMBER

☢ In this procedure, x-ray exposures will be required.

Refer to **Section 6.1.1** for calibration/test set-up.

Refer to **FIGURE 6-2** for preamplifier master gain adjustment location.

1. Set the x-ray generator at 100kVp, SPOT 200mA large focal spot and 5 second backup.

   Select Density N (Normal).
   Select the spot field ion chamber.

2. Position the phantom (10 inches of water or equivalent) as described in **Section 6.1.1.**

☢

3. Place a cassette with an unexposed sheet of film in the cassette holder. Select 1-ON-1 format, with **AUTO SHUTTER ON**. Make an x-ray exposure. Record the mAs reading on the 61017 display board.

4. Develop the film and measure and record the average OD near the center of the exposure.

5. If the OD is 1.20 ± 0.15, proceed to **Section 6.7.**

6. Determine an approximate value of mAs to correspond to OD = 1.20 by using the following equation:

$$\text{New mAs} = \frac{1.20}{\text{OD (from Step 4)}} \times \text{Old mAs (from Step 3)}$$

☢

7. Repeatedly make exposures with the loaded film cassette until adjustment of the preamplifier master gain produces the mAs reading calculated in Step 6. Repeat Steps 3 through 5.

Refer to **FIGURE 6-2** for preamplifier master gain adjustment locations.

6.7 CONCLUSION OF FIELD CALIBRATION

Though not a recommended procedure, if the user desires a "normal" OD other than provided by the calibration procedure, the input amplifier gain (60899 R14) can be adjusted appropriately.

If the optical densities obtained when a second chamber position is selected are generally considered too light or dark, adjust only the master gain at that chamber's preamplifier.

However, if a diagnostically correct field selection for a particular chamber produces a light or dark film, while another diagnostically correct field on the same chamber gives a good film, adjust only the field gain requiring attention.

Refer to **FIGURE 6-2** for preamplifier master gain and field gain adjustments.

The Automatic Exposure Control system is now calibrated and ready for use.

SECTION 7 - IMAGE INTENSIFIER CALIBRATION

7.1 IMAGE TUBE FOCUS

WARNING:

The screwdriver used to adjust P2 must have an insulating shaft and handle.

The potentiometer slider is at 3800 volts with respect to ground, and the insulation value between the slider and the potentiometer shaft is only 1000 volts.

The potentiometers for focus adjustment of the intensifier tube are located on the left side of the power supply and are labeled. The outer cover of the power supply must be removed to have access to these potentiometers.

For the adjustment procedure, it is necessary to use a 0.2-mm spaced metallic (stainless steel or copper) wire mesh of 2/10mm diameter. Attach the wire mesh with masking tape to the spot film device directly beneath the intensifier tube. This screen will provide an adequate image to ensure proper focusing.

With the screen in place, initiate a fluoroscopic exposure and begin adjusting. (Refer to Operation, Chapter 5, for the procedure to take a fluoroscopic exposure.)

To obtain a correct image:

- first check output voltages V4 (+2.5 to 3.0 KVDC) and V5 (+27 ± 0.15 KVDC)

- adjust g1 electrode voltage, V1, by means of potentiometer P8, clockwise from the extreme counterclockwise position until the size of the image goes through a maximum. Stop just beyond the maximum size

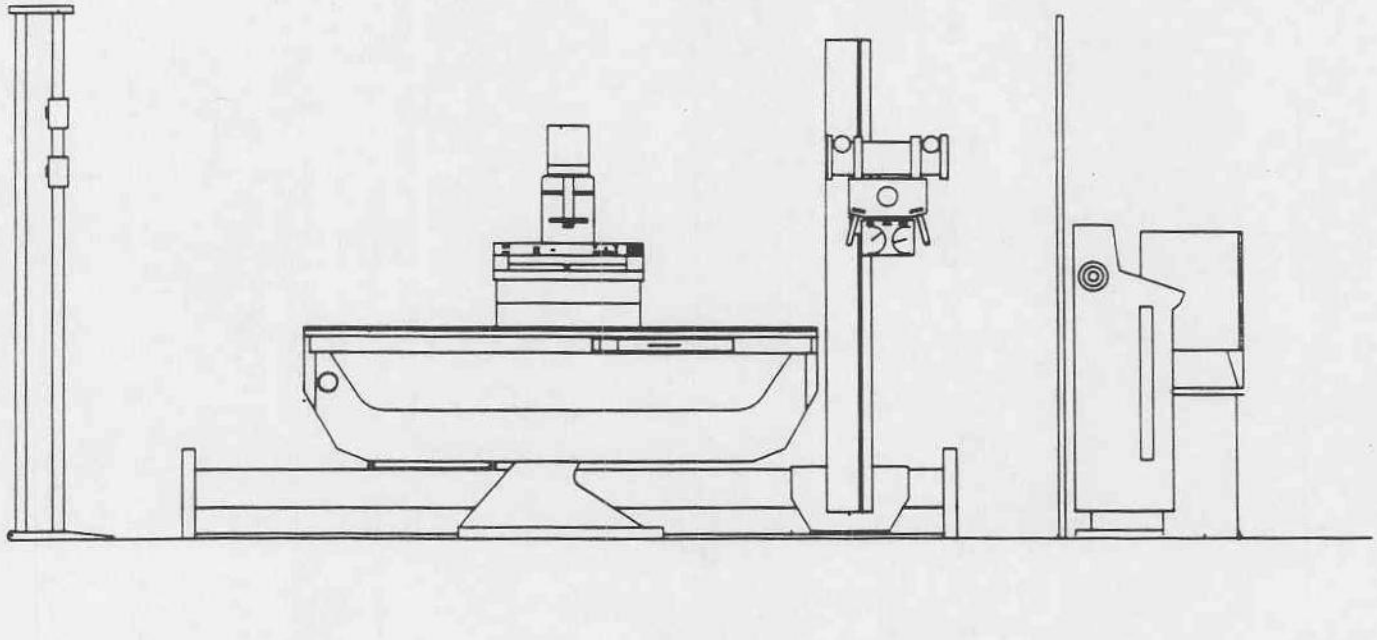
- adjust g2 electrode, V2, by means of potentiometer P5 until optimum focusing is obtained. Slightly readjust g1 electrode voltage, P8, in both directions to determine optimum focus position.

Once the image is satisfactorily adjusted, discontinue the exposure and replace the power supply's outer cover.

END OF SYSTEM CALIBRATION

CHAPTER 4

TROUBLESHOOTING



CHAPTER 4 - TROUBLESHOOTING

TABLE OF CONTENTS

SECTION NUMBER	DESCRIPTION	PAGE NUMBER
SECTION 1 - SUB-SYSTEM TROUBLESHOOTING		Page 1-1
1.1	SCOPE	Page 1-1
1.2	GENERATOR FAULT CONDITIONS	Page 1-1
1.3	X-RAY TABLE FAULT CONDITIONS	Page 1-3
1.4	TUBESTAND FAULT CONDITIONS	Page 1-5
1.5	SPOT FILM DEVICE FAULT CONDITIONS	Page 1-6
1.6	COLLIMATOR FAULT CONDITIONS	Page 1-7
1.7	AEC FAULT CONDITIONS	Page 1-8
1.8	IMAGE INTENSIFIER FAULT CONDITIONS	Page 1-9
SECTION 2 - SYSTEM WIRE LISTS		Page 2-1
2.1	GLOSSARY OF ABBREVIATIONS	Page 2-1
2.2	SYSTEM LEVEL WIRE LIST	Page 2-4
2.3	SFD CABLES	Page 2-33
2.4	ION CHAMBER CABLE	Page 2-37
2.5	SID SW CABLE	Page 2-38
2.6	COLLIMATOR LOGIC CABLE	Page 2-39

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CHAPTER 4 - TROUBLESHOOTING

SECTION 1 - SUB-SYSTEM TROUBLESHOOTING

1.1 SCOPE

This chapter is concerned with troubleshooting the system and the assemblies in the system. It is recommended that the maintenance section of this manual be reviewed in its entirety, including Circuit Function Diagrams (CFDs) and functional block diagrams, for an understanding of the system before troubleshooting.

Circuit Functional Diagrams (CFDs) are provided to show complete functional circuits without regard to physical component placement. CFDs are a bridge between board schematics and system wiring diagrams, and allow service personnel to more clearly visualize the functions of the major circuits in the system.

1.2 GENERATOR FAULT CONDITIONS

1. Generator does not turn on; MAINS switch does not light.
    - in tactical shelter, the field generator not functioning
    - Mains disconnect(s) open (Box A and Box B in tactical shelter)
    - burnt out fuse in Mains disconnect(s)
    - loose connections on input cables
    - blown lines on contactor fuses
    - burnt coil on contactor

2. PREPARE cycle does not complete; PREPARE light does not come on.
    - rotor cable(s) not connected or loose connection
    - Rotor Controller needs adjustment (See CFD 7.0, FIGURE 2-22, Chapter 6.)
    - circuit breaker(s) open in rotor supply
    - Rotor Controller Phase Shift Capacitor shorted or open (See CFD 7.0, FIGURE 2-22, Chapter 6.)
    - fault on Rotor Controller PCB (See CFD 7.0, FIGURE 2-22, Chapter 6.)

3. PREPARE sequence appears OK, but EXPOSURE sequence does not complete.

    - Radiography
        - if SAFETY/RESET lit, check technique factors (OPERATOR ERROR)
        - if READY light of the over-table collimator is not on
            - no cassette present (OPERATOR ERROR)
            - see over-table collimator section in this chapter
        - Backup Contactor not closed (See CFD 6.2, FIGURE 2-20, Chapter 6.)

1.2 GENERATOR FAULT CONDITIONS (continued)

- Spot Film
  - if SAFETY/RESET lit, check technique factors (OPERATOR ERROR)
  - loose Footswitch connections
  - spot film device fault (See spot film section in this chapter.)
  - faulty exposure delay relay (See CFD 8.1, FIGURE 2-23, Chapter 6.)
- Fluoroscopy
  - loose Footswitch connections
  - spot film device fault (See spot film section in this chapter.)
  - fluoro timer not set (OPERATOR ERROR)
  - fluoro timer fault (open)

4. EXPOSURE sequence appears OK, but little or no radiation.

- in the Filament Circuit, the circuit breaker open (CFD 1.2, FIGURE 2-3, Chapter 6.)
- cooling chimney or Filament Control PCB fault (CFD 3.0, CFD 3.1, CFD 3.2, FIGURES 2-11, 2-12.
- poor high voltage jack pin connection
- loose connection in primary power wiring
- dirty contacts on mA select relay(s) (Chapter 6, FIGURE 2-26, CFD 9.3)
- Timer PCB fault (CFD 6.0, CFD 6.3, FIGURES 2-19 and 2-21, Chapter 6.)

5. SAFETY light comes on when taking an exposure.

- mA requires calibration (See Calibration Chapter, paragraph 2.9.)
- cooling chimney filament driver transistor shorted (CFD 3.0, FIGURE 2-11, Chapter 6.)
- fault on Filament Control PCB (CFD 3.0, CFD 3.1, CFD 3.2, FIGURES 2-11, 2-12, and 2-13, Chapter 6.)
- mA Overload Shunt open or miscalibrated (CFD 5.0, FIGURE 2-17, Chapter 6.)
- x-ray tube gassy/arc
- x-ray cable arc
- high voltage generator unbalanced (CFD 1.1, FIGURE 2-2, Chapter 6.)
- high voltage generator short or open (CFD 1.1 FIGURE 2-2, Chapter 6.)

6. Autotimer terminates exposure immediately.

- fault in ion chamber pickup (See AEC troubleshooting, this chapter.)
- fault in autotimer PCBs (See AEC troubleshooting, this chapter.)
- open in density selector(s) (See AEC troubleshooting, this chapter.)

1.2 GENERATOR FAULT CONDITIONS (continued)

7. Autotimer does not terminate exposure.

   - Backup time set too short (CFD 6.2, FIGURE 2-20, Chapter 6.)
   - incorrect field selection (OPERATOR ERROR)
   - incorrect patient position (OPERATOR ERROR)
   - loose or misconnected ion chamber pickup (See AEC troubleshooting)
   - fault in ion chamber pickup (See AEC troubleshooting, this chapter.)
   - fault in autotimer PCBs (See AEC troubleshooting, this chapter.)

8. No Fluoro kVp reading/no Fluoro image

   - Fluoro circuit breaker open (CFD 1.2, FIGURE 2-3, Chapter 6)
   - Fluoro variable transformer damaged (CFD 1.0, FIGURE 2-1, Chapter 6)
   - loose power connection to variable transformer (CFD 1.0, FIGURE 2-1, Chapter 6)
   - open fluoro damper resistor (CFD 1.0, FIGURE 2-1, Chapter 6)

9. Exposure times inaccurate.

   - incorrect timer deck selected (Section 2.2, Chapter 3)
   - dirty or damaged contacts on time select switch (Section 2.20, Chapter 6)
   - shorted SCR contactor (CFD 6.3, FIGURE 2-21, Chapter 6)
   - Timer PCB fault (CFD 6.0, FIGURE 2-19, Chapter 6)
   - Timer not calibrated (See Calibration - Chapter 3, paragraph 2.7)

1.3 X-RAY TABLE FAULT CONDITIONS

1. Table tilt inoperative.

   - already at limits (12 degrees Trendelenburg or 88 degrees vertical)
   - loose cable connection
   - variable speed drive miscalibrated
   - slowdown adjustment miscalibrated
   - tilt circuit breaker open
   - tilt motor or belt inoperative

2. Table body jerks to side when tilting.

   - table base not stable (level)
   - sector guide bearings not adjusted

3. Table bumps and grinds when tilting.

   - tilt chain tension too loose

1.3 X-RAY TABLE FAULT CONDITIONS (continued)

4. Locks inoperative.

    - control switch malfunction
    - lock circuit breaker open
    - loose cable connection
    - Lock Control PCB fault
    - locks improperly adjusted

5. Lock(s) hum loudly.

    - failed filter capacitor on lock
    - locks improperly adjusted

6. Fluoroscopic carriage movement binds or drifts.

    - guide bearing adjusted too tight
    - dirt or foreign matter in bearing path
    - broken bearing
    - cabling catching or rubbing on other objects
    - table not level

7. Longitudinal carriage binds during movement.

    - guide bearing adjusted too tight
    - dirt or foreign matter in bearing path
    - broken bearing
    - cabling catching or rubbing on other objects
    - check counterweights for above conditions

8. Grid cabinet binds during movement.

    - guide bearing adjusted too tight
    - dirt or foreign matter in bearing path
    - broken bearing
    - cabling catching or rubbing on other objects
    - check counterweights for above conditions

9. Grid cabinet cassette sizing does not sense properly.

    - tray not properly inserted (OPERATOR ERROR)
    - loose or broken grid/table connections
    - cassette locating stops incorrectly positioned

1.4 TUBESTAND FAULT CONDITIONS

1. Mechanical motions binding or not smooth.

    - bearings adjusted too tight
    - foreign material in bearing path
    - locks not releasing
    - incorrect counterweighting
    - tubestand not level

2. Electric lock((s) inoperative.

    - poor cable connection
    - pinched or damaged wiring
    - lock failed
    - power supply in auxiliary box failed
    - power supply circuit breaker open
    - lock improperly adjusted

3. Lock hums loudly.

    - capacitor attached to lock connections failed
    - lock improperly adjusted

4. Tubestand will not move in a direction.

    - shipping restraint(s) not removed
    - column rotation lock not loosened

1.5 SPOT FILM DEVICE FAULT CONDITIONS

1. Cassette carriage slams or jams during movement.

    - position sensor flags out of adjustment
    - position sensor failed
    - position sensor connection(s) loose on Interface PCB
    - cassette partially out of carrier (not latched in)
    - clutch-brake inoperative

2. Spot Film Device inoperative.

    - power supply fuse in Aux Cabinet open
    - CPU PCB fault
    - loose wiring
    - loose cable connection
    - power supply switch not turned on
    - power supply fault

3. Cassette carrier does not move, although motor runs.

    - drive belt teeth damaged or belt has jumped a pulley
    - foreign material in carrier path

4. Device senses cassette present without cassette in carrier or never/intermittent senses cassette present.

    - cassette present sensor out of alignment

5. Image size on film smaller than selected.

    - wrong mask or compression cone in field (OPERATOR ERROR)
    - Collimator incorrectly calibrated or inoperative

6. For additional fault conditions, refer to the SFD chapter located in the maintenance manual.

1.6 COLLIMATOR FAULT CONDITIONS

1. The collimator field lamp does not light.
    - collimator field lamp is burned out
    - 27VAC power supply protection fuse (F-2) is open

2. Centerline light cannot be centered.
    - prism/slit bracket out of adjustment
    - under-table image receptor out of alignment
    - source to image distance out of tolerance

3. Exposure Hold Indicator is activated.
    - shutters are not properly aligned
    - vertical SID is not properly positioned at 40" SID
    - horizontal SID is not positioned at a standard SID

4. Manual Indicator is activated
    - collimator is tilted greater than 10 degrees
    - table is tilted greater than 10 degrees vertically and horizontally
    - cassette tray is not fully inserted
    - cassette is not located in Cassette tray

1.7 AEC FAULT CONDITIONS

1. Safety light appears before exposure or Autotimer Reset light appears after exposure.

    - no field or chamber selection (OPERATOR ERROR)
    - paddle/chamber not in collimator - correct detector or tube placement
    - generator back-up time (mAs) too short - set back-up mAs to about 4x expected value
    - chamber/paddle cable broken - check continuity
    - defective chamber/paddle - replace it
    - generator x-ray output low - check generator output and collimator
    - autotimer Reset light indicates AEC terminated exposure at 570 mAs. If the generator is set at maximum mAs, this can be normal. If generator is not set at maximum mAs, this indicates failure of the generator's termination function.

2. Digital display extinguished.

    - power switch is OFF (OPERATOR ERROR)
    - digital display dims automatically after about 6 seconds, and extinguishes after about 6 minutes - press RESET
    - no power to AEC - check fuse on power supply board & cabling

3. Erratic display and exposure times.

    - defective paddle/chamber cable or detector

1.8 IMAGE INTENSIFIER FAULT CONDITIONS

1. Fuzzy and distorted image.

    - mirror out of adjustment
    - dirty mirror(s) or lenses
    - ionized gas in intensifier tube - apply power to intensifier tube and let it run for 24 hours without x-rays
    - focus adjustment out of calibration
    - collimating lens out of focus - refocus collimating lens/tighten collimator clamp

2. Intensifier output glows without x-ray.

    - ionized gas in intensifier tube - apply power to intensifier and let it run for 24 hours without x-rays

3. No output when x-ray applied.

    - power not applied - check incoming power connector
    - power supply failed - replace power supply
    - intensifier insert cracked allowing air into it - replace image intensifier

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SECTION 2 - SYSTEM WIRE LISTS

2.1 GLOSSARY OF ABBREVIATIONS

AEC	Automatic Exposure Control
Asm	Assembly
Asst	Assist
Aux	Auxiliary
Bl	Block
Bz, Buzz	Buzzer
C	Common
CB	Circuit Breaker
Cbl	Cable
Cl	Cooling
CL	Collimator Logic
Ch/over	Changeover
Cntr	Center
Comp	Compensation
Conn	Connector
Ctrl	Control
CVT	Constant Voltage Transformer
Dl	Delay
Dr	Drive
Exp	Exposure
F	Fuse
Flm	Filament
Ftstep	Footstep
Gen	Generator(control)
Grid	Grid Cabinet
Grnd	Ground
HV	High Voltage
Intgr.	Integration
Intrl.	Interlock
Ion	Ion Chamber
Isol	IsolationIon
J	Jack

2.1 GLOSSARY OF ABBREVIATIONs (continued)

Lat	Lateral
Long	Longitudinal
MCC	Motor Carriage Drive
Mjr	Major
MLC	Magnetic Lock Power Supply
Mnr	Minor
Mntng	Mounting
Mtrx.	Matrix
Mtr	Meter
NC	Normally Closed
NO	Normally Open
OT	Over-table
P	Plus
PCB	Printed Circuit Board
Pnl	Panel
Prep	Prepair
P.S.	Power Supply
Pwr	Power
Rad	Radiographic
Rel	Relay
Res	Resistor
Rst	Reset
SF	Spot Film
SFD	Spot Film Device
Sel	Select
SW	Switch
Tab	Tab Terminal
Tbl	Table
Tbst.	Tubestand
Tech.	Technique
TLD	Top Long Drive
Tmr	Timer
Trans	Transverse
Trmnl	Terminal
TS	Terminal Strip
TTC	Table Tilt Control

2.1 GLOSSARY OF ABBREVIATIONs (continued)

Unvrs	Universal
UT	Under-table
Vert	Vertical
VSC	Variac Speed Control
Xfmr	Transformer
φ	Phase
5m.	5 minute
5Fnct	5 Function

2.2 SYSTEM LEVEL WIRE LIST

SIGNAL NAME	WIRE COLOR	FROM	TO
115F	BLK	Gen CB-9	Gen CB-10
115F	BLK	Gen CB-9	Gen Exp/Intrl PCB
115F	GRY	Gen Aux Rel Pnl	Gen Exp/Intrl PCB
115I	RED	Gen CB-3	Gen Aux/Pwr/Xfrm
115S	ORG	Gen CB-12	Gen CVT
115V	BLU	Gen CB-3	Gen Exp/Intrl PCB
115V	BLU	Gen CB-3	Gen CB-9
115V	BLU	Gen CB-9	Gen CB-11
115V	BLU	Gen CVT	Gen TS-18
115V	RED	Gen ION Pwr/RST SW	Gen TS-36
115V	RED	Gen Fan-Left	Gen Unvrs.Tola PCB
115V	BLK	Gen TS-18	Gen Unvrs.Tola PCB
115V	BLU	Gen TS-18	Gen Flm.Dr.Cl.Asm
115V	VIO	Gen Isol/Xfmr/24v	Gen Flm.Ctrl PCB
115V	RED	Gen TS-36	Gen Flm.Ctrl PCB
115V	BRN	Gen TS-36	Gen Exp/Intrl PCB
115V	YEL	Gen Aux/Tech/Sw	Gen Exp/Intrl PCB
115V	VIO	Gen MA Shunts PCB	Gen Exp/Intrl PCB
115V	BLU	Gen TS-36	Gen Fan-Right
115V	BLK	Gen TS-36	Gen TS-18
115V	BLK	Gen TS-18	Cbl 5187.234.04 P15-2
115V	BLK	Aux Box J15-2	Aux Box TS-1
115V	BLK	Aux Box TS-1	Aux Box CB-5
115V	BLK	Aux Box CB-5	Aux Box J16-2
115V	BLK	Cbl 5187.101.02 P16-2	Tbst.SW Box
115V	BLK	Tbst.SW Box	Cbl 5487.101.01 Tab
115V	BLK	Cbl 5487.101.01 SW Box	Tbst.-Fan
115V	BLK	Gen TS-18	Cbl 5187.234.03 P-11
115V	BLK	Tbl J7-11	Tbl TS2
115V	RED	Tbl TS2	Cbl 518.706.212 Fan
115V	BLK	Tbl TS2	Tbl J6-28
115V	WHT/BLK/GRY	Cbl 5187.062.02 P6-28	5187.062.02 P17-28
115V	RED	Gen TS-36	Cbl 5187.234.06 P22-M
115V/TP	BLK	Aux Box J17-28	Aux Box CB-1
115V	BLK	Aux Box TS-1	Aux Box SFD P.S.
115V	BLK	Aux Box TS-1	Aux Box CL

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
12AT	YEL	Gen Ion Pickup SW	Gen AEC TSB-6
15C	GRY	Gen TS-32	Gen MA Shunts PCB
15IT	RED	Gen CB-10	Gen SCR Tmr PCB
15MS	BLK	Gen MAS Intgr	Gen MAS Intgr
230I	BLU	Gen CB-1	Gen Aux/Pwr/Xfrm
230V	RED	Gen CB-1	Gen TS-17
230V	RED	Gen CB-1	Gen CB-2
24BT	GRY	Gen CB-7	Gen Backup Tmr PCB
24I	BRN	Gen CB-5	Gen Aux/Pwr/Xfrm
24KA	VIO	Gen KV Comp.PCB	Gen Isol/Xfrm/24V
24KB	BLU	Gen KV Comp.PCB	Gen Isol/Xfrm/24V
24KB	BLU	Gen KV Comp.PCB	Gen Relay Mtrx.PCB
24P	YEL	Gen Ion Pickup SW	Gen Ion Pwr/Rst SW
24V	BLU	Gen CB-5	Gen SCR Tmr PCB
24V	VIO	Gen CB-5	Gen CB-7
24V	RED	Gen MA Sel SW	Gen CB-7
24V	BLU	Gen SCR Tmr PCB	Gen TS-39
24V	ORG	Gen Aux Rel Pnl	Gen TS-39
24V	GRY	Gen MA Shunts PCB	Gen TS-39
24V	BLU	Gen MA Shunts PCB	Gen Ion Pwr/Rst/SW
24V	YEL	Gen MA Shunts PCB	Gen Exp/End Buzz
24V	YEL	Gen MA Shunts PCB	Gen Exp/Intrl PCB
24V	BRN	Gen Aux/Tech/SW	Gen Exp/Intrl PCB
24V	BRN	Gen Aux/Tech/SW	Gen MA Sel SW
36V	GRY	Aux Box MCC PCB	Aux Box TR-1
36Vr	GRY	Aux Box MLC PCB	Aux Box MCC PCB
3D	BRN	Gen Backup Tmr PCB	Gen Tmr SW Asm

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
60I	ORG	Gen CB-4	Gen Aux/Pwr/Xfmr
60V	BLK	Gen CB-4	Gen Res 10 Ω/100 w
A1	BLK	Gen Auto/Xfrm	Gen Line Coarse SW-1
A2	BLK	Gen Auto/Xfrm	Gen Line Coarse SW-2
A2	BLK	Gen Mjr KVP SW-12	Gen Line Coarse SW-2
A3	BLK	Gen CB-17	Gen Line Coarse SW-3
A3	BLK	Gen Auto/Xfrm	Gen Line Coarse SW-3
A3	BLK	Gen Mjr KVP SW-11	Gen Line Coarse SW-3
A4	BRN	Gen Res Pnl	Gen Line Coarse SW-4
A4	BLK	Gen Auto/Xfrm	Gen Line Coarse SW-4
A4	BLK	Gen Mjr KVP SW-10	Gen Line Coarse SW-4
A5	BLK	Gen Auto/Xfrm	Gen Line Coarse SW-5
A5	BLK	Gen Mjr KVP SW-9	Gen Line Coarse SW-5
A6	BLK	Gen Auto/Xfrm	Gen Line Coarse SW-6
A6	BLK	Gen Mjr KVP SW-8	Gen Line Coarse SW-6
A7	BLK	Gen Auto/Xfrm	Gen Mjr KVP SW-7
A8	BLK	Gen Auto/Xfrm	Gen Mjr KVP SW-6
A9	BLK	Gen Auto/Xfrm	Gen Mjr KVP SW-5
A10	BLK	Gen Auto/Xfrm	Gen Mjr KVP SW-4
A11	BLK	Gen Auto/Xfrm	Gen Mjr KVP SW-3
A12	BLK	Gen Auto/Xfrm	Gen Mjr KVP SW-2
A13	BLK	Gen Auto/Xfrm	Gen Mjr KVP SW-1
A14	ORG	Gen CB-18	Gen Auto/Xfrm
A14	BLK	Gen Auto/Xfrm	Gen Mnr KVP SW-1
A14	BLK	Gen Line Fine SW-7	Gen Mnr KVP SW-1

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
A15	BLK	Gen Auto/Xfrm	Gen Line Fine SW-6
A15	BLK	Gen Mnr KVP SW-2	Gen Line Fine SW-6
A16	BLK	Gen Auto/Xfrm	Gen Line Fine SW-5
A16	BLK	Gen Mnr KVP SW-3	Gen Line Fine SW-5
A17	VIO	Gen Res Pnl	Gen Auto/Xfrm
A17	BLK	Gen Line Fine SW-4	Gen Auto/Xfrm
A17	BLK	Gen Line Fine SW-4	Gen Mnr KVP SW-4
A18	BLK	Gen Auto/Xfrm	Gen Line Fine SW-3
A18	BLK	Gen Mnr KVP SW-5	Gen Line Fine SW-3
A20	BLK	Gen Auto/Xfrm	Gen Line Fine SW-1
A20	BLK	Gen Mnr KVP SW-7	Gen Line Fine SW-1
AA1	VIO	Aux Box K2	Aux Box K-2
AA1	BLK	Aux Box K2	Aux Box J17-31
AA1	WHT/RED/BRN	Cbl 5187.062.02 P17-31	Cbl 5187.062.02 P6-31
AA1	BLU	Tbl J6-31	Tbl TS2
AA1	RED	Tbl TS2	Tbl Tilt Motor
AA2	RED	Aux Box K1	Aux Box J17-34
AA2	ORG	Aux Box K1	Aux Box K1
AA2	BLU	Aux Box K1	Aux Box R3
AA2	RED/YEL	Cbl 5187.062.02 P17-34	Cbl 5187.062.02 P6-34
AA2	RED	Tbl J6-34	Tbl TS2
AA2	BLK	Tbl TS2	Tbl Tilt Motor
AB1	VIO	Aux Box K1	Aux Box K2
AB1	BLK	Aux Box R2	Aux Box K2
AC	ORG	Gen F-3	Gen Res .375 Ω/300 w
ACF	YEL	Gen F-3	Gen CB-24
ACKM	RED	Gen CB-24	Gen KV Comp.PCB
ACM	BLK	Gen RE-24	Gen Res .375 Ω/300w

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
ACR	BLK	Gen RE-22	Gen RE-24
ADR	BLK	Gen RE-24 Coil	Gen MA Sel SW
ADR	BLU	Gen RE-24 Coil	Gen Aux Rel Pnl
AEC	GRY	Aux Box J17-25	Aux Box VSC PCB
AEC	WHT/BLK/GRN	Cbl 5187.062.02 P17-25	Cbl 5187.062.02 P6-25
AEC	VIO	Tbl J6-25	Tbl TS2
AEC		Tbl TS2	Tbl Cntr Slow SW-Nc
AER	BRN	Tbl TS2	Tbl J6-24
AER	WHT/BLK/YEL	Cbl 5187.062.02 P6-24	Cbl 5187.062.02 P17-24
AES	BLU	Aux Box VSC PCB	Aux Box J17-26
AES	WHT/BLK/BLU	Cbl 5187.062.02 P17-26	Cbl 5187.062.02 P6-26
AES	RED	Tbl J6-26	Tbl TS2
AES		Tbl TS2	Tbl End Slow SW-Nc
AEX		Tbl TS2	Tbl Cntr Slow SW-C
AEX		Table TS2	Table End Slow SW-C
AF	RED	Gen CB-14	Gen Fluoro KVP SW-3
AH	BLK	Gen Fluoro KVP SW-1	Gen Mjr KVP SW-8
AL	BLK	Gen Fluoro KVP SW-4	Gen Mjr KVP SW-1
AM	YEL	Gen F-4	Gen SCR Tmr PCB
AMF	BLU	Gen CB-24	Gen F-4
AMR	BLK	Gen RE-21	Gen SCR Tmr PCB
AMW	BLK	Gen CB-23	Gen KV Comp.PCB
ANS	YEL	Aux Box K1	Aux Box K2
ANS	RED	Aux Box TTC PCB	Aux Box K2
ANS	ORG	Aux Box TTC PCB	Aux Box C1(-)
ANS	BLU	Aux Box VSC PCB	Aux Box C1(-)

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
APL	BRN	Aux Box K1	Aux Box K2
APL	GRY	Aux Box R1	Aux Box K2
APP	BLK	Aux Box K1	Aux Box K1
APP	BRN	Aux Box R3	Aux Box K1
APP	GRY	Aux Box R3	Aux Box R2
APP	YEL	Aux Box TTC PCB	Aux Box R2
APP	ORG	Aux Box TTC PCB	Aux Box C1(+)
APP	RED	Aux Box VSC PCB	Aux Box C1(+)
ASE	RED	Aux Box CB-4	Aux Box MLC PCB
ASL	BLU	Aux Box CB-4	Aux Box MLC PCB
AQF	RED	Gen 5 Ω/100 w	Gen Fluoro KVP Mtr
ATO	BLK	Gen Ion Pickup SW	Gen AEC TSA-9
AUX	GRY	Gen TS-34	Gen Aux/Tech/SW
AVF	ORG	Aux Box TTC PCB	Aux Box R1
B	ORG	Gen Flm.Ctrl PCB	Gen Flm.Dr.Cl.Asm
B2	RED	Gen SFD Prep/Dl Rel	Gen TS-7
B2	YEL	Gen Exp/Intrl PC	Gen TS-7
B2	VIO	Gen Exp/Intrl PCB	Gen MA Shunts PCB
BAC		Gen SCR Tmr PCB	Gen SCR Tmr PCB (BAM)
BAL	YEL	Gen SCR Tmr PCB	Gen Prep/Exp SW
BAM	RED	Gen Backup Tmr PCB	Gen SCR Tmr PCB
BAS	BLK	Gen Exp/End Buzz	Gen SCR Tmr PCB
BAS	BRN	Gen Flm.Ctrl PCB	Gen SCR Tmr PCB
BAS	BLU	Gen AEC TSA-3	Gen SCR Tmr PCB

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
BCE	GRY	Gen TS-31	Gen Exp/Intrl PCB
BCE	BRN	Gen TS-31	Cbl 5187.234.04 P15-5
BCE	BLK	Aux Box J15-5	Aux Box CL TS3-11
BPL	GRY	Gen RE-22 (Coil)	Gen Backup Tmr PCB
BSR	YEL	Gen SCR Tmr PCB	Gen AEC TSA-7
BUC	VIO	Gen Backup Tmr PCB	Gen Exp/Intrl PCB
BUQ		Gen Backup Tmr PCB	Gen Backup Tmr (H3)
C1	YEL	Gen Rotor Ctrl PCB	Gen Aux/Tech/SW
CAN	VIO	Aux Box MCC PCB	Aux Box J17-5
CAN	GRN	Cbl 5187.062.02 P17-5	Cbl 5187.062.02 P6-5
CAN	BLU	Tbl J6-5	Tbl TS1
CAN	WHT/BLK	Cbl 5187.062.16 TS1	Tbl TS3
CAN	BLK	Tbl TS3	Tbl Pwr/Asst Motor
CAP	RED	Aux Box MCC PCB	Aux Box J17-3
CAP	ORG	Cbl 5187.062.02 P17-3	Cbl 5187.062.02 P6-3
CAP	GRY	Tbl J6-3	Tbl TS1
CAP	BLU/WHT	Cbl 5187.062.16 TS1	Tbl TS3
CAP	RED	Tbl TS3	Tbl Pwr/Asst Motor
CE	BLU	Gen Aux Rel Pnl	Gen Prep/Exp SW
CFR	ORG	Aux Box J17-4	Aux Box MLC PCB
CFR	YEL	Aux Box MCC PCB	Aux Box MLC PCB
CFR	YEL	Cbl 5187.062.02 P17-4	Cbl 5187.062.02 P6-4
CFR	YEL	Tbl J6-4	Tbl J1-5
CFR	GRN	Cbl 5187.062.11 P1-5	SFD J9-2
CHR	BLK	Aux Box J17-2	Aux Box MLC PCB
CHR	BRN	Aux Box MCC PCB	Aux Box MLC PCB
CHR	RED	Cbl 5187.062.02 P17-2	Cbl 5187.062.02 P6-2
CHR	ORG	Tbl J6-2	Tbl J1-7
CHR	VIO	Cbl 5187.062.11 P1-7	SFD J9-1

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
CL	BLU	Gen MA Shunts PCB	Gen Prep/Exp SW
CL1	YEL	Gen Rotor Ctrl PCB	Gen Aux/Tech/SW
CLR	BRN	Gen SFD Prep/DI Rel	Gen TS-12
CM	BLU	Gen RE-20 (Coil)	Gen Rotor Ctrl PCB
CN	GRY	Gen RE-20 (Coil)	Gen Rotor Ctrl PCB
CSF	GRY	Aux Box K2	Aux Box VSC PCB
CSR	BRN	Aux Box K2	Aux Box VSC PCB
CSR	BRN	Aux Box VSC PCB	Aux Box VSC PCB
D2T	BLU	Gen SCR Tmr PCB	Gen Tmr SW Asm
DB	GRN	Tbl Grid TS-11	Tbl Grid Lock SW-2
DB	RED	Tbl Grid TS-11	Tbl Grid Lock
DBR	ORG	Gen Backup Tmr PCB	Gen Tmr SW Asm
DLD	RED	Aux Box MLC PCB	Aux Box J17-9
DLD	WHT	Cbl 5187.062.02 P17-9	Cbl 5187.062.02 P6-9
DLD	BRN	Tbl J6-9	Tbl J1-1
DLD	BRN	Cbl 5187.062.11 P1-1	SFD J8-1
DLL	BLU	Aux Box MLC PCB	Aux Box J17-10
DLL	BLK	Cbl 5187.062.02 P17-10	Cbl 5187.062.02 P6-10
DLL	VIO	Tbl J6-10	Tbl TS1
DLL	BLK	Cbl 5187.062.12 TS1	Tbl 4 Pin conn-1
DLL	BLK	Tbl 4 Pin conn-1	Tbl Lat lock
DLL	BLK	Tbl Lat lock	Tbl Long lock

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
DLN	RED	Aux Box J16-4	Aux Box TS
DLN	BLU	Aux Box MLC PCB	Aux Box TS
DLN	VIO	Aux Box MLC PCB	Aux Box J17-11
DLN	WHT/BRN	Cbl 5187.062.02 P17-11	Cbl 5187.062.02 P6-11
DLN	RED	Tbl J6-11	Tbl TS1
DLN	BLK	Tbl TS-1	Tbl Carriage lock
DLN	WHT	Cbl 5187.062.12 TS1	Tbl 4 Pin conn-2
DLN	WHT	Tbl 4 Pin conn-2	Tbl Lat lock
DLN	WHT	Tbl Lat lock	Tbl Long lock
DLN	GRN/BLK	Tbl TS1	Cbl 5187.062.16 TS4
DLN	GRN	Cbl 5187.062.14 TS4	Tbl Grid TS-12
DLN	BLK	Tbl Grid TS-12	Tbl Grid Lock
DLN	BLK	Tbl Grid TS-12	Tbl Grid Lock SW
DLN	BLK	Tbl TS4	Tbl Intrl Rel-14
DLN	BLU	Cbl 5187.101.02 P16-4	Tbs t.SW Box
DLN	WHT	Tbst.SW Box	Tbst.Vert Lock
DLN	BLK	Tbst.SW Box	Tbst.Trans lock
DLN	RED	Tbst.SW Box	Tbst.Long lock
DLN	ORG	Cbl 5487.101.01 SW Box	Tbst.Roll lock
DLP	VIO	Aux Box CB-6	Aux Box TS
DLP	BLU	Aux Box MLC PCB	Aux Box TS
DLP	GRY	Aux Box MLC PCB	Aux Box J17-12
DLP	WHT/RED	Cbl 5187.062.02 P17-12	Cbl 5187.062.02 P6-12
DLP	ORG	Tbl J6-12	Tbl TS1
DLP	ORG	Tbl TS1	Tbl J1-2
DLP	RED	Cbl 5187.062.11 P1-2	SFD J8-2
DLP	RED/BLK	Cbl 5187.062.16 TS1	Cbl 5187.062.16 TS4
DLP	RED	Cbl 5187.062.14 TS4	Tbl Grid TS-10
DLP	RED	Cbl 5187.062.18 TS4	Ftstep Intrl SW-Con
DLP	RED	Tbl Grid TS-10	Tbl Grid Lock SW-1

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
DLPr	ORG	Aux Box CB-6	Aux Box J16-3
DLPr	BRN	Cbl 5187.101.02 P16-3	Tbs t.SW Box
DLPr	BRN	Cbl 5487.101.01 SW Box	Tbst.Roll SW
DPG	BRN	Aux Box TTC PCB	Aux Box VSC PCB
DSC	BLK	Gen AEC J7-5	Gen SF Ch/over PCB
DSCC	BRN	Gen Ion Pickup SW	Gen SF Ch/over PCB
DSCS	BLK	Gen TS-40	Gen SF Ch/over PCB
DSCS	BLK	Gen TS-40	Cbl 5187.234.01 P4-23
DSCS	BRN	Tbl J4-23	Tbl J2-21
DSCS	BRN	Cbl 5187.062.012 P2-21	SFD SW2
DSH	WHT	Gen TS-41	Gen Ion Pickup SW
DSH	WHT	Gen TS-41	Gen AEC J7-10
DSH	WHT	Gen TS-41	Cbl 5187.234.01 P4-24
DSH	RED	Tbl J4-24	Tbl J2-22
DSH	RED	Cbl 5187.062.012 P2-22	SFD SW3
DSL	RED	Gen TS-42	Gen AEC J7-11
DSL	RED	Gen TS-42	Gen Ion Pickup SW
DSL	RED	Gen TS-42	Cbl 5187.234.01 P4-22
DSL	BLK	Tbl J4-22	Tbl J2-20
DSL	BLK	Cbl 5187.062.012 P2-20	SFD SW1
E	GRY	Gen Flm.Ctrl PCB	Gen Flm.Dr.Cl.Asm
EFO	VIO	Gen Aux Rel Pnl	Gen Exp/Intrl PCB
EFO	GRY	Gen Ion Pickup SW	Gen Exp/Intrl PCB
ER	VIO	Gen Aux/Tech/SW	Gen Exp/Intrl PCB
ERE	YEL	Gen Ion Pickup SW	Gen Exp/Intrl PCB
ERO	BLU	Gen Aux Rel Pnl	Gen Ion Pickup SW
ERR	ORG	Gen Unvrs.Tola PCB	Gen Tmr SW Asm
ERS	VIO	Gen Ion Pickup SW	Gen Aux Rel Pnl

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
ERX	BLU	Gen Aux/Tech/SW	Gen Tmr SW Asm
ES	BLU	Gen Aux/Tech/SW	Gen Exp/Intrl PCB
FE		Gen Rotor Ctrl PCB	Gen Rotor Ctrl PCB(HF)
FE	BRN	Gen Rotor Ctrl PCB	Gen SF Ch/over PCB
FE	VIO	Gen Rotor Ctrl PCB	Gen TS-15
FE	BLU	Gen MA Shunts PCB	Gen TS-15
FE	GRY	Gen Aux Rel Pnl	Gen TS-15
FE	YEL	Gen Aux Rel Pnl	Gen MA Sel SW
FE	RED/BLK	Gen TS-15	Cbl 5187.234.03 P7-7
FE	BLU	Tbl J7-7	Tbl J1-16
FE	WHT/BLU	Cbl 5187.062.011 P1-16	SFD J7-2
FL	GRY	Gen TS-12	Gen SF Ch/over PCB
FL	ORN/BLK	Gen TS-14	Cbl 5187.234.03 P7-6
FL	YEL	Tbl J7-6	Tbl J1-17
FL	WHT/YEL	Cbl 5187.062.011 P1-17	SFD J7-1
FS1	YEL	Gen AEC J5	Gen Ion Pwr/Rst SW
FS2	ORG	Gen AEC J5	Gen Ion Pwr/Rst SW
FS3	BLK	Gen AEC J5	Gen Ion Pwr/Rst SW
FSC	BLU	Gen AEC J5	Gen Ion Pwr/Rst SW
FSW1	WHT/RED	SFD J10-1	Cbl 5187.062.011 P1-12
FSW1	ORG	Tbl J1-12	Tbl J11-2
FSW1	WHT	Cbl 5187.062.05 P11-2	Foot SW
FSW2	PINK	SFD J10-2	Cbl 5187.062.011 P1-13
FSW2	GRY	Tbl J1-13	Tbl J11-3
FSW2	BRN	Cbl 5187.062.05 P11-3	Foot SW
FT	ORG	Gen Rel Mtrx.PCB	Gen 5m.Fluoro Tmr SW
FT	BLK	Gen 5m.Fluoro Tmr SW	Gen 5m.Fluoro Tmr SW
FTE	BLK	Gen Rel Mtrx.PCB	Gen 5m.Fluoro Tmr SW
FTE	VIO	Gen Time Expired Bz	Gen 5m.Fluoro Tmr SW

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
G	GRN	Gen GRND Block	Gen Pwr Trmnl Block
G	GRN	Gen GRND Block	Gen Pwr Trmnl Block
G	GRN	Gen GRND Block	Gen TS-16
G	GRN	Gen Exp/Intrl PCB	Gen TS-37
G	GRN	Gen MA Shunts PCB	Gen TS-26
G	GRN	Gen MA Shunts PCB	Gen MA Mtr (-)
G	GRN	Gen Exp/Intrl PCB	Gen AEC TS3
G	GRN	Gen Mntng Stud	Gen AEC TS3
G	GRN	Gen TS-16	Gen TS-26
G	GRN	Gen TS-37	Gen TS-26
G	GRN	Aux Box J16-5	Aux Box TS
G	GRN	Aux Box Mntng Stud	Aux Box TS
G	GRN	Aux Box J15-3	Aux Box TS
G	GRN	Aux Box J17-37	Aux Box TS
G	GRN	Aux Box SFD P.S.	Aux Box TS
G	GRN	Aux Box CL	Aux Box TS
G	GRN	Gen Pwr Trmnl Bl-G	Pwr Cbl Box B
G	GRN	Box B	Box A
G	GRN	Gen TS-16	Cbl 5187.234.03 P7-13
G	GRN	Tbl J7-13	Tbl TS1
G	GRN	Tbl TS1	Tbl TS2
G	GRN	Tbl TS1	Tbl J11-1
G	GRN	Cbl 5187.062.05 P11-1	Foot SW
G	GRN	Tbl TS2	Tbl J6-37
G	GRN	Cbl 5187.062.02 P6-37	Cbl 5187.062.02 P17-37
G	GRN	Aux Box J17-37	Aux Box TS
G	GRN	Cbl 5187.234.04 P15-3	Gen TS-16
G	GRN	Cbl 5187.101.02 P16-5	Tbst.SW Box
G	GRN	Tbst.SW Box	
		Cbl 5487.101.01	Tbst.Ctrl Box
H1F	BLK	Gen Res 10 Ω/100 w	Gen Rotor Ctrl PCB
H2F	BRN	Gen CB-2	Gen Rotor Ctrl PCB
H3	RED	Gen Rotor Ctrl PCB	Gen Backup Tmr PCB
H3	RED	Gen Backup Tmr PCB	Gen Backup Tmr PCB (BUQ)
H3	RED	Gen Rotor Ctrl PCB	Gen Rotor Ctrl PCB
H3	ORG	Gen Rotor Ctrl PCB	Gen Prep/Exp SW
H3	YEL	Gen Rotor Ctrl PCB	Gen SF Ch/over PCB
H3	BRN	Gen RE-21 (Coil)	Gen Backup Tmr PCB

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
H5	ORG	Gen Rotor Ctrl PCB	Gen TS-30
H5	RED	Gen TS-30	Cbl 5187.234.04 P15-6
H5	RED	Aux Box J15-6	Aux Box CL TS3-12
H6	YEL	Gen Backup Tmr PCB	Gen Rotor Ctrl PCB
H6T	BLK	Gen Backup Tmr PCB	Gen SCR Tmr PCB
H7A	ORG	Gen Rotor ϕ Shift Cap	Gen Rotor Ctrl PCB
H8	BRN	Gen Rotor ϕ Shift Cap	Gen Rotor Ctrl PCB
HF	GRY	Gen Rotor Ctrl PCB	Gen Rotor Ctrl PCB-FE
KVC	GRY	Tbl TS2	Tbl J1-3
KVC	ORN	Cbl 5187.062.11 P1-3	SFD J8-3
KVC	RED	Cbl 5187.062.10 TS2	Tbl Carriage lock
KVM	YEL	Gen MA Shunts PCB	Gen RAD KVP Mtr
KWH	YEL	Gen Unvrs.Tola PCB	Gen Tmr SW Asm.
KWL	GRY	Gen Unvrs.Tola PCB	Gen Tmr SW Asm.
L1	VIO	Gen F-1	Gen RE-20
L1	BLK	Gen RE-20	Gen Pwr Trmnl Bl-L1
L1	BLK	Gen Pwr Trmnl Bl-L1	Pwr Cbl Box B
L1	BLK	Box B	Box A
L1F	GRY	Gen CB-26	Gen Aux/Tech/SW
L1P	GRY	Gen CB-26	Gen F-1
L2	RED	Gen F-2	Gen RE-20
L2	BLK	Gen RE-20	Gen Pwr Trmnl Bl-L2
L2	WHT	Gen Pwr Trmnl Bl-L2	Pwr Cbl Box B
L2	WHT	Pwr Cbl Box B	Pwr Cbl Box A
L2F	VIO	Gen CB-27	Gen Rotor Ctrl PCB
L2P	VIO	Gen CB-27	Gen F-2

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
LCH	BLU	Gen MA Shunts PCB	Gen Line Mtr (+)
LCL	BLK	Gen MA Shunts PCB	Gen Line Mtr (-)
LL	BLK	Aux Box K1 (Coil)	Aux Box J17-32
LL	WHT/RED/RED	Cbl 5187.062.02 P17-32	Cbl 5187.062.02 P6-32
LL	BRN	Tbl J6-32	Tbl TS2
LL	WHT	Tbl TS2	Tbl TS2 (N)
LL1	GRN	Tbl TLD PCB J101-7	Cbl 5187.062.22 P101-7
LL1	GRN	Cbl 5187.062.22 P101-7	Tbl Left Cntr SW-Nc
LR	VIO	Aux Box K2 (Coil)	Aux Box J17-33
LR	RED/BLK	Cbl 5187.062.02 P17-33	Cbl 5187.062.02 P6-33
LR	VIO	Tbl J6-33	Tbl TS1
LR	RED	Cbl 5187.062.16 TS1	Tbl TS3
LR	RED	Tbl TS3	Cbl 5187.062.13 TS3
LR	RED	Cbl 5187.062.13 P100-12	Tbl TLD PCB
LR	RED	Tbl TLD PCB	Cbl 5187.062.22 P101-8
LR	RED	Cbl 5187.062.22 P101-8	Tbl Right Cntr SW-Nc
M	ORG	Gen MA Mtr (+)	Gen MAS Intgr PCB
M1	YEL	Gen TS-27	Gen Exp/Intrl PCB
M1	ORG	Gen TS-27	Cbl 5187.234.06 P22-D
M1A	YEL	Gen Exp/Intrl PCB	Gen MAS Intgr PCB
M2	BLU	Gen TS-28	Gen AEC TSA-1
M2	BLK/WHT	Gen TS-28	Cbl 5187.234.06 P22-E
M2A	BLK	Gen Exp/Intrl PCB	Gen AEC TSA-2
MA	VIO	Gen MA Sel SW	Gen MAS Mtr (-)
MA	VIO	Gen MA Sel SW	Gen Exp/Intrl PCB
MA	VIO	Gen MAS Intgr PCB	Gen Exp/Intrl PCB
MA	VIO	Gen MAS Intgr PCB	Gen MAS Intgr PCB
MM	VIO	Gen MAS Mtr (+)	Gen MAS Intgr PCB
MMF	BLK	Gen MA Shunts PCB	Gen SF Ch/over PCB

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
MRY	YEL	Gen Unvrs.Tola PCB	Gen KV Comp.PCB
MRY	BRN	Gen MA Shunts PCB	Gen KV Comp.PCB
MS1	YEL	Gen MA Shunts PCB	Gen SF Ch/over PCB
MS2	BRN	Gen MA Rel Mtrx.PCB	Gen MA Shunts PCB
MS3	BLU	Gen MA Rel Mtrx.PCB	Gen MA Shunts PCB
MS4	BLU	Gen MA Rel Mtrx.PCB	Gen MA Shunts PCB
MS5	ORG	Gen MA Rel Mtrx.PCB	Gen MA Shunts PCB
MS6	YEL	Gen MA Rel Mtrx.PCB	Gen MA Shunts PCB
MS7	GRY	Gen MA Rel Mtrx.PCB	Gen MA Shunts PCB
MS8	BLK	Gen MA Rel Mtrx.PCB	Gen MA Shunts PCB
MSR1	RED	Gen Aux/Tech/SW	Gen MAS Intgr PCB
MSS1	BLU	Gen MA Rel Mtrx.PCB	Gen SF Ch/over PCB
MST	BLU	Gen MA Rel Mtrx.PCB	Gen MA Rel Mtrx.PCB
MV	YEL	Gen Flm.Ctrl PCB	Gen Unvrs.Tola PCB
MV	YEL	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
MV	RED	Gen MA Shunts PCB	Gen Unvrs.Tola PCB
MV	BRN	Gen MA Shunts PCB	Gen AEC TSA-10
MV	ORG	Gen Rad KVP Mtr(-)	Gen AEC TSA-10
MV1	BLK	Gen KV Comp.PCB	Gen Rel Mtrx.PCB
MV2	VIO	Gen KV Comp.PCB	Gen Rel Mtrx.PCB
MV3	YEL	Gen KV Comp.PCB	Gen Rel Mtrx.PCB
MV4	GRY	Gen KV Comp.PCB	Gen Rel Mtrx.PCB
MV5	RED	Gen KV Comp.PCB	Gen Rel Mtrx.PCB

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
MV6	ORG	Gen KV Comp.PCB	Gen Rel Mtrx.PCB
MV7	BLK	Gen KV Comp.PCB	Gen Rel Mtrx.PCB
MV8	VIO	Gen KV Comp.PCB	Gen Rel Mtrx.PCB
MVD	BLU	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
MVH	BLK	Gen AEC TSA-11	Gen Unvrs.Tola PCB
MVH	BLU	Gen Flm.Ctrl PCB	Gen Unvrs.Tola PCB
MVT	BRN	Gen Rel Mtrx.PCB	Gen Rel Mtrx.PCB
MY1	BLU	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
MY2	ORG	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
MY3	BRN	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
MY4	BLK	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
MY5	ORG	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
MY6	VIO	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
MY7	YEL	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
MY8	GRY	Gen Unvrs.Tola PCB	Gen Aux Rel Pnl
N	WHT	Gen GRND Block	Gen Aux/Pwr/Xfrm
N	WHT	Gen GRND Block	Gen TS-3
N	WHT	Gen Rotor Ctrl PCB	Gen Rotor Ctrl PCB
N	WHT	Gen Rotor Ctrl PCB	Gen Backup Tmr PCB
N	WHT	Gen Rotor Ctrl PCB	Gen SCR Tmr PCB
N	WHT	Gen CVT Asm	Gen SCR Tmr PCB
N	WHT	Gen SFD Prep/Dl Rel	Gen SCR Tmr PCB
N	WHT	Gen TS-9	Gen SCR Tmr PCB
N	WHT	Gen TS-33	Gen Flm.Dr.Cl.Asm
N	WHT	Gen Fan-left	Gen Backup Tmr PCB

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
N	WHT	Gen RE-24 (Coil)	Gen Backup Tmr PCB
N	WHT	Gen RE-24 (Coil)	Gen RE-22 (Coil)
N	WHT	Gen RE-22 (Coil)	Gen RE-23 (Coil)
N	WHT	Gen RE-23 (Coil)	Gen RE-21 (Coil)
N	WHT	Gen Unvrs.Tola PCB	Gen Rotor Ctrl PCB
N	WHT	Gen Isol/Xfrm/24V	Gen Flm.Ctrl PCB
N	WHT	Gen Rel Mtrx.Pnl	Gen Flm.Ctrl PCB
N	WHT	Gen Rel Mtrx.Pnl	Gen Aux Rel Pnl
N	WHT	Gen TS-19	Gen Aux Rel Pnl
N	WHT	Gen Fan-right	Gen Flm.Res.Pnl
N	WHT	Gen SF Ch/over PCB	Gen Flm.Res.Pnl
N	WHT	Gen TS-19	Gen Flm.Res.Pnl
N	WHT	Gen Aux/Tech/SW	Gen MA Sel SW
N	WHT	Gen Aux/Tech/SW	Gen MA Sel SW
N	WHT	Gen Time Expired Bz	Gen MA Sel SW
N	WHT	Gen Time Expired Bz	Gen 5m.Fluoro Tmr
N	WHT	Gen Prep/Exp SW	Gen 5m.Fluoro Tmr
N	WHT	Gen AEC TS3	Gen 5m.Fluoro Tmr
N	WHT	Gen AEC TS3	Gen AEC TSA-8
N	WHT	Gen AEC TS3	Gen MAS Intgr.PCB
N	WHT	Gen AEC TS3	Gen Exp/Intrl PCB
N	WHT	Gen Exp/End Buzz	Gen Exp/Intrl PCB
N	WHT	Gen MA Shunts PCB	Gen Exp/Intrl PCB
N	WHT	Gen TS-38	Gen Exp/Intrl PCB
N	WHT	Gen MA Shunts PCB	Gen Fluoro Exp/Ind.Asm
N	WHT	Gen Ion Pickup SW	Gen Ion Pwr/Rst SW
N	WHT	Gen Ion Pickup SW	Gen TS-19
N	WHT	Gen TS-3	Gen TS-9
N	WHT	Gen TS-9	Gen TS-19
N	WHT	Gen TS-19	Gen TS-33
N	WHT	Gen TS-33	Gen TS-38
N	WHT	Gen TS-3	Cbl 5187.234.06 P22-L
N	WHT	Gen TS-3	Cbl 5187.234.02 P5-1
N	WHT	Cbl 5187.062.06 J5-1	Cbl 5187.062.06 J8-1
N	WHT	Cbl 5187.062.061 P8-1	Tbl UT Tube
N	WHT	Gen TS-3	Cbl 5187.234.03 P7-12
N	WHT	Tbl J7-12	Tbl TS1,TS2
N	WHT	Tbl TS1	Cbl 5187.062.16 TS3
N	WHT	Tbl TS3	Cbl 5187.062.13 P100-9
N	WHT	Cbl 5187.062.13 J100-9	Tbl TLD J100-9

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
N	WHT	Tbl TS3	Cbl 5187.062.15 P102-5
N	WHT	Cbl 5187.062.15 P102-5	Tbl 5 Fnct.Ctrl SW
N	WHT	Tbl TS2	Cbl 5187.062.12 Fan
N	WHT	Tbl TS2	Tbl J6-14
N	WHT/YEL	Cbl 5187.062.02 P6-14	Cbl 5187.062.02 P17-14
N	WHT	Aux Box J17-14	Aux Box TTC PCB
N	WHT	Aux Box MLC PCB	Aux Box TTC PCB
N	WHT	Aux Box MLC PCB	Aux Box VSC PCB
N	WHT	Aux Box MCC PCB	Aux Box VSC PCB
N	WHT	Tbl TLD PCB J101-6	Cbl 5187.062.22 P101-6
N	WHT	Cbl 5187.062.22 P101-6	Tbl Lim SW 5,6-Nc
N	WHT	Gen TS-3	Cbl 5187.234.04 P15-1
N	WHT	Aux Box J15-1	Aux Box TS-2
N	WHT	Aux Box TS-2	Aux Box J16-1
N	WHT	Cbl 5187.101.02 P16-1	Tbst.SW Box
N	WHT	Tbst.SW Box	Cbl 5487.101.01 Fan
N	WHT	Aux Box TS-2	Aux Box SFD P.S.
N	WHT	Aux Box TS-2	Aux Box CL
NLR	PNK	Tbl TLD PCB J101-16	Cbl 5187.062.22 P101-16
NLR	PNK	Cl5187.062.22 P101-16	Tbl 0" Left Cntr SW
NLR	BLK	Tbl TLD PCB J101-16	Cbl 5187.062.22 P101-16
NLR	BLK	Cbl 5187.062.22 P101-16	Table 11" Left Cntr SW
O7	BLU	Gen Rotor Ctrl PCB	Gen TS-1
O7	BLK	Gen TS-1	Cbl 5187.234.08 P28-2
O7	BLK	Cbl 5187.101.04 J28-2	Cbl 5187.101.-4 J12-2
O7	BLK	Cbl 5187.101.041 P12-2	Tbst.OT Tube
O8	GRY	Gen Rotor Ctrl PCB	Gen TS-2
O8	RED	Gen TS-2	Cbl 5187.234.08 P28-3
O8	RED	Cbl 5187.101.04 J28-3	Cbl 5187.101.04 J12-3
O8	RED	Cbl 5187.101.041 P12-3	Tbst.OT Tube
OHO	GRY	Gen Rotor Ctrl PCB	Gen Exp/Intrl PCB
OHO	VIO	Gen Prep/Exp SW	Gen Exp/Intrl PCB

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
P1	WHT	HV Xfrm J23	Cbl 5187.232.05 P23
P1	WHT	Gen Pwr Trmnl Bl-P1	Cbl 5187.232.05 P23
P1	BLK	Gen Pwr Trmnl Bl-P1	Gen RE-21
P2	BLK	HV Xfrm J23	Cbl 5187.232.05 P23
P2	BLK	Gen Pwr Trmnl Bl-P2	Cbl 5187.232.05 P23
P2	BLK	Gen Pwr Trmnl Bl-P2	Gen RE-22
P2	BLK	Gen RE-22	Gen RE-23
QF	VIO	Gen CB-14	Gen Res 5 Ω/100 w
QU	GRY	Gen TS-29	Gen Exp/Intrl PCB
QU	RED/BLK	Gen TS-29	Cbl 5187.234.06 P22-A
R1	ORG	Gen Rel Mtrx.PCB	Gen Aux Rel Pnl
R1	ORG	Gen MA Sel SW	Gen Aux Rel Pnl
R2	YEL	Gen MA Sel SW	Gen Aux Rel Pnl
R2	YEL	Gen Rel Mtrx.PCB	Gen Aux Rel Pnl
R3	BRN	Gen Rel Mtrx.PCB	Gen Aux Rel Pnl
R3	BRN	Gen MA Sel SW	Gen Aux Rel Pnl
R4	GRY	Gen MA Sel SW	Gen Aux Rel Pnl
R4	GRY	Gen Rel Mtrx.PCB	Gen Aux Rel Pnl
R5	BLK	Gen Rel Mtrx.PCB	Gen Aux Rel Pnl
R5	BLK	Gen MA Sel SW	Gen Aux Rel Pnl
R6	BLU	Gen MA Sel SW	Gen Aux Rel Pnl
R6	BLU	Gen Rel Mtrx.PCB	Gen Aux Rel Pnl
R7	VIO	Gen Rel Mtrx.PCB	Gen Aux Rel Pnl
R7	VIO	Gen MA Sel SW	Gen Aux Rel Pnl
R8	YEL	Gen MA Sel SW	Gen Aux Rel Pnl
R8	YEL	Gen Rel Mtrx.PCB	Gen Aux Rel Pnl

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
RAB	BRN	Gen Ion Pickup SW	Gen AEC TSB-3
RAS	ORG	Gen Ion Pickup SW	Gen AEC TSB-1
RL	BLU	Gen Flm.Ctrl PCB	Gen TS-13
RL	ORG	Gen SF Ch/over PCB	Gen TS-13
RL	BLU	Gen SFD Prep/Dl Rel	Gen TS-13
RL	RED	Gen TS-13	Cbl 5187.234.03 P7-5
RL	GRY	Tbl J7-5	Tbl TS2
RL	RED	Tbl TS2	Tbl J1-18
RL	GRY	Tbl TS2	Tbl J6-36
RL	WHT/GRN	Cbl 5187.062.11 P1-18	SFD J7-3
RL	WHT/RED/BLU	Cbl 5187.062.02 P6-36	Cbl 5187.062.02 P17-36
SLL	YEL	Tbl TLD PCB J101-10	Cbl 5187.062.22 P101-10
SLL	YEL	Cbl 5187.062.22 P101-10	Tbl Left Cntr SW-C
SLR	GRY	Tbl TLD PCB J101-2	Cbl 5187.062.22 P101-2
SLR	GRY	Cbl 5187.062.22 P101-2	Tbl Right Cntr SW-C
SO	ORG	Gen TS-24	Gen MA Shunts PCB
SO	BLK	Gen TS-24	Cbl 5187.234.06 P22-H
SR1		Gen Flm.Dr.Cl.-TS	Gen Flm.Ctrl Xfrm-TS
SR1		Gen Flm.Dr.Cl.-TS	Gen Res 75 Ω/100 w
SR2		Gen Flm.Dr.Cl.-TS	Gen Flm.Ctrl Xfrm-TS
SR2		Gen Flm.Dr.Cl.-TS	Gen Res 75 Ω/100 w
SU	YEL	Gen TS-25	Gen MA Shunts PCB
SU	GRN/BLK	Gen TS-25	Cbl 5187.234.06 P22-J
T1	RED	Gen RE-20	Gen Res Pnl Asm
T1A	RED	Gen CB-17	Gen Aux/Pwr/Xfrm
T1A	VIO	Gen Rotor Ctrl PCB	Gen Aux/Pwr/Xfrm
T2	GRY	Gen RE-20	Gen Res Pnl Asm

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
T2L	RED	Gen CB-18	Gen Aux/Pwr/Xfrm
T2L	RED	Gen Rotor Ctrl PCB	Gen Aux/Pwr/Xfrm
TCC	RED	Tbl TS3	Cbl 5187.062.15 P102-11
TCC	RED	Cbl 5187.062.15 P102-11	Tbl 5 Fnct.SW J102-11
TCC	GRN	Tbl TS3	Cbl 5187.062.13 P100-7
TCC	RED	Cbl 5187.062.13 P100-7	Tbl TLD PCB J100-7
TD	BLK	Aux Box TTC PCB	Aux Box J17-21
TD	WHT/BLK/GRN	Cbl 5187.062.02 P17-21	Cbl 5187.062.02 P6-21
TD	GRY	Tbl J6-21	Tbl TS2
TD		Tbl TS2	Tbl Trend Lim.SW
TDE	BLK	Aux Box TTC PCB	Aux Box J17-19
TDE	TAN	Cbl 5187.062.02 P17-19	Cbl 5187.062.02 P6-19
TDE	RED	Tbl J17-19	Tbl TS1
TDE	GRY	Tbl TS1	Tbl J1-20
TDE	RED/YEL	Cbl 5187.062.11 P1-20	SFD J9-10
TDE	ORG	Tbl TS1	Cbl 5187.062.16 TS3
TDE	BLU	Tbl TS3	Cbl 5187.062.15 P102-1
TDE	BLU	Cbl 5187.062.15 P102-1	Tbl 5 Fnct.SW J102-1
TE	GRY	Gen Rel Mtrx.PCB	Gen SF Ch/over PCB
TE	GRY	Gen 5m.Fluoro Tmr SW	Gen SF Ch/over PCB
TEE	YEL	Aux Box TTC PCB	Aux Box J17-15
TEE	WHT/GRN	Cbl 5187.062.02 P17-15	Cbl 5187.062.02 P6-15
TEE	YEL	Tbl J6-15	Tbl TS2
TEE		Tbl TS2	Tbl Hor.Stop SW-No
THC	RED	Aux Box TTC PCB	Aux Box J17-17
THC	WHT/VIO	Cbl 5187.062.02 P17-17	Cbl 5187.062.02 P6-17
THC	BRN	Tbl TS2	Tbl Hor.Stop SW-Nc

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
THL	ORG	Aux Box TTC PCB	Aux Box J17-16
THL	WHT/BLU	Cbl 5187.062.02 P17-16	Cbl 5187.062.02 P6-16
THL	BLU	Tbl J6-16	Tbl TS2
THL		Tbl TS2	Tbl Hor.Stop SW-C
TL	BLU	Gen RE-23 (Coil)	Gen TS-10
TL	VIO	Gen Rel Mtrx.PCB	Gen TS-10
TL	BLK/WHT	Gen TS-10	Cbl 5187.062.03 P7-3
TL	RED	Tbl J7-3	Tbl TS2
TL	VIO	Tbl TS2	Tbl J11-4
TL	BLK	Cbl 5187.062.05 P11-4	Foot SW
TLB	BRN	Gen Rel Mtrx.PCB	Gen Fluoro Exp/Ind.Asm
TLH	BLU	Gen TS-11	Gen Fluoro MA Ctrl Asm
TLH	ORG	Gen TS-11	Cbl 5187.234.03 P7-4
TLH	ORG	Tbl J7-4	Tbl TS2
TLH	BLU	Tbl TS2	Tbl J11-5
TLH	BLU	Cbl 5187.062.05 P11-5	Foot SW
TLR	GRY	Gen Rel Mtrx.PCB	Gen Fluoro MA Ctrl Asm
TLR	YEL	Aux Box K1 (Coil)	Aux Box J17-29
TLR	PINK	Cbl 5187.062.02 P17-29	Cbl 5187.062.02 P6-29
TLR	GRY	Tbl J6-29	Tbl TS1
TLR	BRN	Cbl 5187.062.17 TS1	Tbl TS4
TLR	ORG	Tbl TS4	Tbl Intrl Rel-10
TLS	TAN	Tbl TS1	Cbl 5187.062.17 TS4
TLS	BRN	Tbl TS4	Tbl Intrl Rel-6
TLS		Tbl TS1	Tbl TS2
TLS		Tbl TS2	Tbl Trend Lim.SW-Nc
TOL	VIO	Gen Unvrs.Tola PCB	Gen Trm SW Asm
TRI	RED	Gen SCR Tmr PCB	Gen Tmr SW Asm
TRR	BLU	Aux Box K2 (Coil)	Aux Box J17-35
TRR	WHT/RED/GRN	Cbl 5187.062.02 P17-35	Cbl 5187.062.02 P6-35
TRR	ORG	Tbl J6-35	Tbl TS1
TRR	RED	Cbl 5187.062.17 TS1	Cbl 5187.062.17 TS3
TRR	BLU	Tbl TS3	Tbl Intrl Rel-9

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
TRS	PINK	Tbl TS1	Cbl 5187.062.17 TS3
TRS	VIO	Tbl TS3	Tbl Intrl Rel-5
TRS		Tbl TS1	Tbl TS2
TRS		Tbl TS2	Tbl Vert.Lim.SW-Nc
TP	BLU	Aux Box CB-1	Aux Box J17-28
TPA	RED	Aux Box CB-2	Aux Box J17-1
TPA	BRN	Cbl 5187.062.02 P17-1	Cbl 5187.062.02 P6-1
TPA	RED	Tbl J6-1	Tbl J1-6
TPA	BLU	Cbl 5187.062.11 P1-6	SFD J9-3
TPF	BRN	Aux Box CB-1	Aux Box CB-2
TPF	BRN	Aux Box CB-3	Aux Box CB-2
TPF	BRN	Aux Box CB-3	Aux Box K2
TPF	BRN	Aux Box K1	Aux Box K2
TPF	BRN	Aux Box K1	Aux Box TTC PCB
TPF	BRN	Aux Box J17-13	Aux Box TTC PCB
TPF	BRN	Aux Box MLC PCB	Aux Box TTC PCB
TPF	BRN	Aux Box MLC PCB	Aux Box VCC PCB
TPF	WHT/ORG	Cbl 5187.062.02 P17-13	Cbl 5187.062.02 P6-13
TPF	GRY	Tbl J6-13	Tbl TS1
TPF	YEL	Tbl TS1	Tbl J1-21
TPF	RED/GRN	Cbl 5187.062.11 P1-21	SFD J9-12
TPF	BLK	Tbl TS1	Cbl 5187.062.16 TS3
TPF	BLK	Cbl 5187.062.15 P102-3	Tbl 5 Fnct.SW J102-3
TTD	YEL	Tbl TS1	Tbl J6-30
TTD	WHT/BLK/BLK	Cbl 5187.062.02 P6-30	Cbl 5187.062.02 P17-30
TTD	BLU	Cbl 5187.062.16 TS1	Tbl TS4
TTD	BLU	Cbl 5187.062.13 TS4	Cbl 5187.062.13 P100-14
TTD	BLU	Cbl 5187.062.13 P100-14	Tbl TLD PCB J100-14

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
TVD	WHT/BLK/VIO	Cbl 5187.062.02 P17-27	Cbl 5187.062.02 P6-27
TVD	ORG	Tbl J6-27	Tbl TS1
TVD	RED	Tbl TS1	Tbl J1-9
TVD	WHT	Cbl 5187.062.11 P1-9	SFD J8-8
TVD	GRY	Tbl TS1	Tbl J1-11
TVD	WHT/BLK	Cbl 5187.062.11 P1-11	SFD J8-10
TVD	ORG/BLK	Tbl TS1	Cbl 5187.062.16 TS3
TVD	BLK	Cbl 5187.062.13 P100-8	Tbl TLD PCB J100-8
TVD	VIO	Cbl5187.062.15 P102-14	Tbl 5 Fnct.SW J102-14
TVD		Tbl TS4	Tbl TS3 (TTD)
TU	BLU	Aux Box TTC PCB	Aux Box J17-20
TU	WHT/BLK	Cbl 5187.062.02 P17-20	Cbl 5187.062.02 P6-20
TU	ORG	Tbl TS2	Tbl Vert.Lm.SW-C
TUE	VIO	Aux Box TTC PCB	Aux Box J17-18
TUE	WHT/GRY	Cbl 5187.062.02 P17-18	Cbl 5187.062.02 P6-18
TUE	VIO	Tbl J17-18	Tbl TS1
TUE	ORG	Tbl TS1	Tbl J1-19
TUE	RED/BLK	Cbl 5187.062.11 P1-19	SFD J9-11
TUE	GRN	Tbl TS1	Cbl 5187.062.16 TS3
TUE	GRN	Cbl 5187.062.16 P101-7	Tbl 5 Fnct.SW J101-7
U7	YEL	Gen Rotor Ctrl PCB	Gen TS-4
U7	BLK	Gen TS-4	Cbl 5187.234.02 P5-2
U7	BLK	Cbl 5187.062.06 J5-2	Cbl 5187.062.06 J8-2
U7	BLK	Cbl 5187.062.061 P8-2	Tbl UT Tube
U8	RED	Gen Rotor Ctrl PCB	Gen TS-5
U8	RED	Gen TS-5	Cbl 5187.234.02 P5-3
U8	RED	Cbl 5187.062.06 J5-3	Cbl 5187.062.06 J8-3
U8	RED	Cbl 5187.062.061 P8-3	Tbl UT Tube
UF	YEL	Gen RE-23	Gen Auto/Xfrm (A20)
UF	GRY	Gen Fluoro KVP Mtr	Gen Auto/Xfrm
UFF	BLK	Gen RE-21	Gen RE-23

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
WP	GRY	Gen Ion Pwr/Rst SW	Gen AEC TS3
WPN	VIO	Gen AEC J7-9	Gen Ion Pwr/Rst SW
WPL	BLU	Gen AEC J7-8	Gen Ion Pwr/Rst SW
WPQ	GRY	Gen AEC J7-2	Gen Ion Pwr/Rst SW
WPR	YEL	Gen AEC J7-3	Gen Ion Pwr/Rst SW
XA1	ORG	Gen Flm.Ctrl PCB	Gen SF Ch/over PCB
XA2	GRY	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XA3	BRN	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XA4	RED	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XA5	VIO	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XA6	BLK	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XA7	BLU	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XA8	ORG	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XAF	BLU	Gen Flm.Ctrl PCB	Gen SF Ch/over PCB
XAS1	VIO	Gen Rel Mtrx.PCB	Gen SF Ch/over PCB
XAT	BRN	Gen Rel Mtrx.PCB	Gen Rel Mtrx.PCB
XB	BLK	Gen Flm.Ctrl PCB	Gen Flm.Ctrl Xfrm
XBR	YEL	Gen Backup Tmr PCB	Gen Res Pnl Asm

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
XC1	BRN	Gen Rel Mtrx.PCB	Gen Fluoro MA Ctrl Asm
XCC	ORG	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XCF	YEL	Gen Rel Mtrx.PCB	Gen Fluoro MA Ctrl Asm
XD	BLU	Gen Backup Tmr PCB	Gen Aux Rel PCB
XD	VIO	Gen Flm.Ctrl PCB	Gen Aux Rel PCB
XD1	VIO	Gen Flm.Ctrl PCB	Gen Fluoro MA Ctrl Asm
XDC	YEL	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XDF	RED	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XFN	ORG	Gen Flm.Ctrl PCB	Gen Fluoro MA Ctrl Asm
XLO	BRN	Gen Aux Rel PCB	Gen Flm.Res PCB
XLO	RED	Gen TS-21	Gen Flm.Res PCB
XLO	BLU	Gen TS-21	Cbl 5187.234.06 P22-C
XLU	BLK	Gen Flm.Res PCB	Gen Res 500 Ω/100 w
XLU	YEL	Gen Flm.Res PCB	Gen TS-23
XLU	BLU	Gen Flm.Res PCB	Gen SF Ch/over PCB
XLU	BLU/BLK	Gen TS-23	Cbl 5187.234.06 P22-G
XRP	VIO	Gen Res 500 Ω/100 w	Gen SF Ch/over PCB
XS1	GRY	Gen Flm.Ctrl PCB	Gen SF Ch/over PCB
XS2	BRN	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XS3	RED	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XS4	VIO	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XS5	BLK	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
XS6	BLU	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XS7	ORG	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XS8	GRY	Gen Flm.Ctrl PCB	Gen Rel Mtrx.PCB
XSP	BLU	Gen CB-12	Gen Flm.Ctrl Xfrm F-10
XSO	BLU	Gen Aux Rel Pnl	Gen Flm.Res PCB
XSO	BLK	Gen TS-20	Gen Flm.Res PCB
XSO	WHT/BLK	Gen TS-20	Cbl 5187.234.06 P22-B
XSPP		Gen Flm.Ctrl Xfrm F10	Gen Flm.Ctrl Xfrm
XSR1	ORG	Gen Aux Rel Pnl	Gen SF Ch/over PCB
XSS1	ORG	Gen Rel Mtrx.PCB	Gen SF Ch/over PCB
XST	VIO	Gen Rel Mtrx.PCB	Gen Rel Mtrx.PCB
XSU	ORG	Gen TS-22	Gen Flm.Res PCB
XSU	BLK	Gen SF Ch/over PCB	Gen Flm.Res Asm
XSU	ORG/BLK	Gen TS-22	Cbl 5187.234.06 P22-F
ZA1	BLK	Tbl TLD PCB	Tbl Top Drv Mtr-A1
ZA2	RED	Tbl TLD PCB	Tbl Top Drv Mtr-A2
ZAL	BRN	Tbl TLD PCB J101-9	Cbl 5187.062.22 P101-9
ZAL	BRN	Cbl 5187.062.22 P101-9	Tbl Left Lim SW-C
ZAN	BLK	Tbl TLD PCB	Tbl Cap 1000 mF/200V
ZAP	RED	Tbl TLD PCB	Tbl Cap 1000 mF/200V
ZAR	VIO	Tbl TLD PCB J101-11	Cbl 5187.062.22 P101-11
ZAR	VIO	Cbl 5187.062.22 P101-11	Tbl Right Lim SW-C

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
ZDL	BLU	Tbl TLD PCB J101-17	Cbl 5187.062.22 P101-17
ZDL	BLU	Cbl 5187.062.22 P101-17	Tbl Left Lim SW-No
ZDR	ORG	Tbl TLD PCB J101-18	Cbl 5187.062.22 P101-18
ZDR	ORG	Cbl 5187.062.22 P101-18	Tbl Right Lim SW-No
ZLL	VIO	Tbl TS1	Tbl J1-8
ZLL	GRY	Cbl 5187.062.011 P1-8	SFD J8-7
ZLL	GRN/WHT	Cbl 5187.062.16 TS1	Tbl TS3
ZLL	ORG	Cbl 5187.062.13 TS3	Cbl 5197.062.13 P100-5
ZLL	ORG	Cbl 5187.062.13 P100-5	Tbl TLD PCB J100-5
ZLL	ORG	Cbl 5187.062.15 TS3	Cbl 5187.062.15 P102-15
ZLL	ORG	Cbl 5187.062.15 P102-15	Tbl 5 Fnct.SW J102-15
ZLL	BRN	Tbl TLD PCB J101-9	Cbl 5187.062.22 P101-9
ZLL	BRN	Cbl 5187.062.22 P101-9	Tbl Left Lim.SW-C
ZLR	ORG	Tbl TS1	Tbl J1-10
ZLR	BLK	Cbl 5187.062.011 P1-10	SFD J8-9
ZLR	RED/WHT	Cbl 5187.062.16 TS1	Tbl TS3
ZLR	BRN	Cbl 5187.062.13 TS3	Cbl 5187.062.13 P100-13
ZLR	BRN	Cbl 5187.062.13 P100-13	Tbl TLD PCB J100-13
ZLR	BRN	Cbl 5187.062.15 TS3	Cbl 5187.062.15 P102-13
ZLR	BRN	Cbl 5187.062.15 P102-13	Tbl 5 Fnct.SW P102-13

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
J1-A	RED	Tbl TS1	Tbl J1-10
J1-A	BLK	Cbl 5187.062.03 P9-10	Cbl 5187.062.03 P18-10
J1-A	BLK	Aux Box J18-10	Aux Box CL
J1-A	GRY	Cbl 5187.062.17 TS1	Tbl TS4
J1-A	GRY	Cbl 5187.062.14 TS4	Tbl Grid T7-7
J1-B	ORG	Tbl TS1	Tbl J9-12
J1-B	RED	Cbl 5187.062.03 P9-12	Cbl 5187.062.03 P18-12
J1-B	RED	Aux Box J18-12	Aux Box CL
J1-B	VIO	Cbl 5187.062.17 TS1	Tbl TS4
J1-B	VIO	Cbl 5187.062.14 TS4	Tbl Grid TS8-8
J1-C	GRY	Tbl TS1	Tbl J9-13
J1-C	GRN	Cbl 5187.062.03 P9-13	Cbl 5187.062.03 P18-13
J1-C	GRN	Aux Box J18-13	Aux Box CL
J1-C	ORG	Cbl 5187.062.17 TS1	Tbl TS4
J1-C	ORG	Cbl 5187.062.14 TS4	Tbl Grid TS5-5
J1-D	YEL	Tbl TS1	Tbl J9-14
J1-D	WHT	Cbl 5187.062.03 P9-14	Cbl 5187.062.03 P18-14
J1-D	WHT	Aux Box J18-14	Aux Box CL
J1-D	YEL	Cbl 5187.062.17 TS1	Tbl TS4
J1-D	YEL	Cbl 5187.062.14 TS4	Tbl Grid T4-4
J1-15	GRY	Tbl TS1	Tbl J10-4
J1-15	GRN	Cbl 5187.062.04 P10-4	Cbl 5187.062.04 P21-4
J1-15	GRN	Aux Box J21-4	Aux Box CL TS2-5
J1-15	GRN	Cbl 5187.062.17 TS1	Tbl TS4
J1-15	GRN	Tbl TS4	Tbl Tilt Monitor
J1-17	RED	Tbl TS1	Tbl J10-1
J1-17	BLK	Cbl 5187.062.04 P10-1	Cbl 5187.062.04 P21-1
J1-17	BLK	Aux Box J21-1	Aux Box CL TS2-10
J1-17	BLK	Cbl 5187.062.17 TS1	Tbl TS4
J1-17	BLK	Tbl TS4	Tbl Tilt Monitor
J10-2	ORG	Tbl TS1	Tbl J10-2
J10-2	WHT	Cbl 5187.062.04 P10-2	Cbl 5187.062.04 P21-2
J10-2	WHT	Aux Box J21-2	Aux Box CL TS2-9
J10-2	WHT	Cbl 5187.062.17 TS1	Tbl TS4
J10-2	WHT	Tbl TS4	Tbl Tilt Monitor

2.2 SYSTEM LEVEL WIRE LIST (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
J10-5	YEL	Tbl TS1	Tbl J10-5
J10-5	BLU	Cbl 5187.062.04 P10-5	Cbl 5187.062.04 P21-5
J10-5	RED	Aux Box J21-5	Aux Box CL TS2-6
J10-5	BLU	Cbl 5187.062.17 TS1	Tbl TS4
J10-5	BLU	Tbl TS4	Tbl Tilt Monitor

2.3 SFD CABLES

SIGNAL NAME	WIRE COLOR	FROM	TO
CH.GRND	GRN	SFD TS-8	Cbl 5187.062.011 P1-23
CH.GRND	BRN	Tbl J1-23	Tbl J9-1
CH.GRND	BRN	Cbl 5187.062.03 P9-1	Cbl 5187.062.03 P18-1
CH.GRND	GRN	Aux Box J18-1	Aux Box SFD P.S.
115VAC	BLK	SFD TS-6	Cbl 5187.062.011 P1-24
115VAC	RED	Tbl J1-24	Tbl J9-2
115VAC	RED	Cbl 5187.062.03 P9-2	Cbl 5187.062.03 P18-2
115VAC	BLK	Aux Box J18-2	Aux Box SFD P.S.
79VDC	ORG	SFD TS-3	Cbl 5187.062.011 P1-26
79VDC	ORG	Tbl J1-26	Tbl J9-3
79VDC	ORG	Cbl 5187.062.03 P9-3	Cbl 5187.062.03 P18-3
79VDC	ORG	Aux Box J18-3	Aux Box SFD P.S.
LG GND	BLU	SFD TS-2	Cbl 5187.062.011 P1-28
LG GRD	YEL	Tbl J1-28	Tbl J9-4
LG GRD	YEL	Cbl 5187.062.03 P9-4	Cbl 5187.062.03 P18-4
LG GRD	BLU	Aux Box J18-4	Aux Box SFD P.S.
28VAC	VIO	SFD J1-4	Cbl 5187.062.011 P1-29
28VAC	BLK	Tbl J1-29	Tbl J9-5
28VAC	PINK	Cbl 5187.062.03 P9-5	Cbl 5187.062.03 P18-5
28VAC	VIO	Aux Box J18-5	Aux Box SFD P.S.

2.3 SFD CABLES (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
0VAC	BRN	SFD J1-1	Cbl 5187.062.011 P1-30
0VAC	BLU	Tbl J1-30	Tbl J9-6
0VAC	BLU	Cbl 5187.062.03 P9-6	Cbl 5187.062.03 P18-6
0VAC	BRN	Aux Box J18-6	Aux Box SFD P.S.
0VAC	WHT	SFD TS-7	Cbl 5187.062.011 P1-31
0VAC	VIO	Tbl J1-31	Tbl J9-7
0VAC	VIO	Cbl 5187.062.03 P9-7	Cbl 5187.062.03 P18-7
0VAC	WHT	Aux Box J18-7	Aux Box SFD P.S.
24VDC	RED	SFD TS-5	Cbl 5187.062.011 P1-32
24VDC	GRY	Tbl J1-32	Tbl J9-8
24VDC	GRY/BLK	Cbl 5187.062.03 P9-8	Cbl 5187.062.03 P18-8
24VDC	RED	Aux Box J18-8	Aux Box SFD P.S.
LG GRD	GRY	SFD TS-4	Cbl 5187.062.011 P1-33
LG GRD	WHT	Tbl J1-33	Tbl J9-9
LG GRD	WHT/BLK	Cbl 5187.062.03 P9-9	Cbl 5187.062.03 P18-9
LG GRD	GRY	Aux Box J18-9	Aux Box SFD P.S.
SHLD	SHLD	SFD Chassis	Cbl 5187.062.011 P9-35
SHLD	SHLD	Tbl J1-35	Tbl J9-11
SHLD	SHLD	Cbl 5187.062.03 P9-11	Cbl 5187.062.03 P18-11
SHLD	SHLD	Aux Box J18-11	Aux Box SFD P.S.
VCD/REF	RED/BLK	SFD UT LG PCB J2-1	Cbl 5187.062.012 P2-1
VCD/REF	RED/BLK	Tbl J2-1	Cbl 5187.062.11 J29-1
VDC/REF	RED/BLK	Cbl 5187.062.11 P29-1	Tbl UT Collimator
+15V/C	GRN	SFD UT LG PCB J2-2	Cbl 5187.062.012 P2-2
+15V/C	GRN	Tbl J2-2	Cbl 5187.062.11 J29-2
+15V/C	GRN	Cbl 5187.062.11 P29-2	Tbl UT Collimator
SHLD	SHLD	SFD UT LG PCB J2-3	Cbl 5187.062.012 P2-3
SHLD	SHLD	Tbl J2-3	Cbl 5187.062.11 J29-3
SHLD	SHLD	Cbl 5187.062.11 P29-3	Tbl UT Collimator
VCP/R	GRN/BLK	SFD UT LG PCB J2-4	Cbl 5187.062.012 P2-4
VCP/R	GRN/BLK	Tbl J2-4	Cbl 5187.062.11 J29-4
VCP/R	GRN/BLK	Cbl 5187.062.11 P29-4	Tbl UT Collimator

2.3 SFD CABLES (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
VXFL	RED/WHT	SFD UT LG PCB J2-5	Cbl 5187.062.012 P2-5
VXFL	RED/WHT	Tbl J2-5	Cbl 5187.062.11 J29-5
VXFL	RED/WHT	Cbl 5187.062.11 P29-5	Tbl UT Collimator
VXFL/R	WHT/BLK	SFD UT LG PCB J2-6	Cbl 5187.062.012 P2-6
VXFL/R	WHT/BLK	Tbl J2-6	Cbl 5187.062.11 J29-6
VXFL/R	WHT/BLK	Cbl 5187.062.11 P29-6	Tbl UT Collimator
VXFC/R	BLK/WHT	SFD UT LG PCB J2-7	Cbl 5187.062.012 P2-7
VXFC/R	BLK/WHT	Tbl J2-7	Cbl 5187.062.11 J29-7
VXFC/R	BLK/WHT	Cbl 5187.062.11 P29-7	Tbl UT Collimator
VXFC	GRN/WHT	SFD UT LG PCB	Cbl 5187.062.012 P2-8
VXFC	GRN/WHT	Tbl J2-8	Cbl 5187.062.11 J29-8
VXFC	GRN/WHT	Cbl 5187.062.11 P29-8	Tbl UT Collimator
+15V	RED	SFD UT LG PCB J2-9	Cbl 5187.062.012 P2-9
+15V	RED	Tbl J2-9	Cbl 5187.062.11 J29-9
+15V	RED	Cbl 5187.062.11 P29-9	Tbl UT Collimator
LO	BLU	SFD UT LG PCB J2-10	Cbl 5187.062.012 P2-10
LO	BLU	Tbl J2-10	Cbl 5187.062.11 J29-10
LO	BLU	Cbl 5187.062.11 P29-10	Tbl UT Collimator
LC	BLU/BLK	SFD UT LG PCB J2-11	Cbl 5187.062.012 P2-11
LC	BLU/BLK	Tbl J2-11	Cbl 5187.062.11 J29-11
LC	BLU/BLK	Cbl 5187.062.11 P29-11	Tbl UT Collimator
CRO	ORG	SFD UT LG PCB J2-12	Cbl 5187.062.012 P2-12
CRO	ORG	Tbl J2-12	Cbl 5187.062.11 J29-12
CRO	ORG	Cbl 5187.062.11 P29-12	Tbl UT Collimator
CRC	ORG/BLK	SFD UT LG PCB J2-13	Cbl 5187.062.012 P2-13
CRC	ORG/BLK	Tbl J2-13	Cbl 5187.062.11 J29-13
CRC	ORG/BLK	Cbl 5187.062.11 P29-13	Tbl UT Collimator
24VAC	WHT	SFD UT LG PCB J2-14	Cbl 5187.062.012 P2-14
24VAC	WHT	Tbl J2-14	Cbl 5187.062.11 J29-14
24VAC	WHT	Cbl 5187.062.11 P29-14	Tbl UT Collimator

2.3 SFD CABLES (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
24VAC	BLK	SFD UT LG PCB J2-15	Cbl 5187.062.012 P2-15
24VAC	BLK	Tbl J2-15	Cbl 5187.062.11 J29-15
24VAC	BLK	Cbl 5187.062.11 P29-15	Tbl UT Collimator
CSID	RED	SFD UT LG PCB JI-5	Cbl 5187.062.012 P2-23
CSID	WHT	Tbl J2-23	Cbl 5187.062.10 SID Pot
CSID/R	GRN	SFD UT LG PCB J1-18	Cbl 5187.062.012 P2-24
CSID/R	GRN	Tbl J2-24	Cbl 5187.062.10 SID Pot
RESET	ORG	SFD ION Ch.DB9-4	Cbl 5187.062.013 P3-1
RESET	WHT	Tbl J3-1	Tbl J4-12
RESET	ORG	Cbl 5187.234.01 P4-12	Gen AEC J3
OUTPUT	YEL	SFD ION Ch.DB9-5	Cbl 5187.062.013 P3-2
OUTPUT	RED	Tbl J3-2	Tbl J4-13
OUTPUT	YEL	Cbl 5187.234.01 P4-13	Gen AEC J3
+15V	VIO	SFD ION Ch.DB9-8	Cbl 5187.062.013 P3-3
+15V	ORG	Tbl J3-3	Tbl J4-14
+15V	VIO	Cbl 5187.234.01 P4-14	Gen AEC J3
-15V	BLU	SFD ION Ch.DB9-7	Cbl 5187.062.013 P3-4
-15V	BLK	Tbl J3-4	Tbl J4-15
-15V	BLU	Cbl 5187.234.01 P4-15	Gen AEC J3
GRND	BLK	SFD ION Ch.DB9-1	Cbl 5187.062.013 P3-5
GRND	BLU	Tbl J3-5	Tbl J4-16
GRND	BLK	Cbl 5187.234.01 P4-16	Gen AEC J3
GRND	SHLD	SFD ION Chamber	Cbl 5187.062.013 P3-6
GRND	SHLD	Tbl J3-6	Tbl J4-17
GRND	SHLD	Cbl 5187.234.01 P4-17	Gen AEC J3
GRND	WHT	SFD ION Ch.DB9-9	Cbl 5187.062.013 P3-7
GRND	VIO	Tbl J3-7	Tbl J4-18
GRND	WHT	Cbl 5187.234.01 P4-18	Gen AEC J3

2.4 ION CHAMBER CABLE

SIGNAL NAME	WIRE COLOR	FROM	TO
FLD/SEL1	RED	Gen AEC J2	Cbl 5187.234.01 P4-1
FLD/SEL1	RED	Tbl J4-1	Tbl Grid DB9-3
FLD/SEL2	BRN	Gen AEC J2	Cbl 5187.234.01 P4-2
FLD/SEL2	BRN	Tbl J4-2	Tbl Grid DB9-2
FLD/SEL3	GRN	Gen AEC J2	Cbl 5187.234.01 P4-3
FLD/SEL3	GRN	Tbl J4-3	Tbl Grid DB9-6
RESET	ORG	Gen AEC J2	Cbl 5187.234.01 P4-4
RESET	ORG	Tbl J4-4	Tbl Grid DB9-4
OUTPUT	YEL	Gen AEC J2	Cbl 5187.234.01 P4-5
OUTPUT	YEL	Tbl J4-5	Tbl Grid DB9-5
+15V	VIO	Gen AEC J2	Cbl 5187.234.01 P4-6
+15V	VIO	Tbl J4-6	Tbl Grid DB9-8
-15V	BLU	Gen AEC J2	Cbl 5187.234.01 P4-7
-15V	BLU	Tbl J4-7	Tbl Grid DB9-7
GRND	BLK	Gen AEC J2	Cbl 5187.234.01 P4-8
GRND	BLK	Tbl J4-8	Tbl Grid DB9-1
GNRD	SHLD	Gen AEC J2	Cbl 5187.234.01 P4-9
GRND	SHLD	Tbl J4-9	Tbl Grid DB9-9

2.5 SID SW CABLE

SIGNAL NAME	WIRE COLOR	FROM	TO
	BLK	Aux Box CL TS1-17	Aux Box J20-1
	BLK	Cbl 5187.101.03 P20-1	Tbst.Vert.SID SW
	WHT	Aux Box CL TS1-19	Aux Box J20-2
	WHT	Cbl 5187.101.03 P20-2	Tbst.Vert.SID SW
	RED	Aux Box CL TS1-20	Aux Box J20-3
	RED	Cbl 5187.101.03 P20-3	Tbst.Hor.SID SW
	GRN	Aux Box CL TS1-14	Aux Box J20-4
	GRN	Cbl 5187.101.03 P20-4	Tbst.Hor.SID SW

2.6 COLLIMATOR LOGIC CABLE

SIGNAL NAME	WIRE COLOR	FROM	TO
C=-90	GRN/WHT	Aux Box CL TS3-7	Aux Box J19-1
C=-90	GRN/WHT	Cbl 5187.101.01 P19-1	Cbl 5187.101.01 J13-1
C=-90	GRN/WHT	Cbl 5187.101.011 P13-1	Tbst.OT Clm-T
C=+90 T=+90	RED/GRN	Aux Box CL TS3-9	Aux Box J19-2
C=+90 T=+90	RED/GRN	Cbl 5187.101.01 P19-2	Cbl 5187.101.01 J13-2
C=+90 T=+90	RED/GRN	Cbl 5187.101.011 P13-2	Tbst.OT Clm-N
C=+90	WHT/RED	Aux Box CL TS3-6	Aux Box J19-3
C=+90	WHT/RED	Cbl 5187.101.01 P19-3	Cbl 5187.101.01 J13-3
C=+90	WHT/RED	Cbl 5187.101.011 P13-3	Tbst.OT Clm-S
STERO/TOMO	WHT	Aux Box CL TS4-11	Aux Box J19-4
STERO/TOMO	WHT	Cbl 5187.101.01 P19-4	Cbl 5187.101.01 J13-4
STERO/TOMO	WHT	Cbl 5187.101.011 P13-4	Tbst.OT Clm-C
72"SID	BLU/RED	Aux Box CL TS4-9	Aux Box J19-5
72"SID	BLU/RED	Cbl 5187.101.01 P19-5	Cbl 5187.101.01 J13-5
72"SID	BLU/RED	Cbl 5187.101.011 P13-5	Tbst.OT Clm-J
C=0/T=0	RED/WHT/GRN	Aux Box CL TS3-10	Aux Box J19-6
C=0/T=0	RED/WHT/GRN	Cbl 5187.101.01 P19-6	Cbl 5187.101.01 J13-6
C=0/T=0	RED/WHT/GRN	Cbl 5187.101.011 P13-6	Tbst.OT Clm-BB
IR/TRUE	WHT/RED/ORG	Aux Box CL TS4-18	Aux Box J19-7
IR/TRUE	WHT/RED/ORG	Cbl 5187.101.01 P19-7	Cbl 5187.101.01 J13-7
IR/TRUE	WHT/RED/ORG	Cbl 5187.101.011 P13-7	Tbst.OT Clm-AA
VIRL	GRN	Aux Box CL TS4-5	Aux Box J19-8
VIRL	GRN	Cbl 5187.101.01 P19-8	Cbl 5187.101.01 J13-8
VIRL	GRN	Cbl 5187.101.011 P13-8	Tbst.OT Clm-D
GRND	RED/BLK	Aux Box CL TS4-4	Aux Box J19-9
GRND	RED/BLK	Cbl 5187.101.01 P19-9	Cbl 5187.101.01 J13-9
GRND	RED/BLK	Cbl 5187.101.011 P13-9	Tbst.OT Clm-F

2.6 COLLIMATOR LOGIC CABLE (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
GND	BLK/RED	Aux Box CL TS4-4	Aux Box J19-10
GND	BLK/RED	Cbl 5187.101.01 P19-10	Cbl 5187.101.01 J13-10
GND	BLK/RED	Cbl 5187.101.011 P13-10	Tbst.OT Clm-P
TBL/L SID SW	BLU/WHT	Aux Box CL TS4-17	Aux Box J19-13
TBL/L SID SW	BLU/WHT	Cbl 5187.101.01 P19-13	Cbl 5187.101.01 J13-13
TBL/L SID SW	BLU/WHT	Cbl 5187.101.011 P13-13	Tbst.OT Clm-V
40"SID	BLU/BLK/WHT	Aux Box CL TS4-14	Aux Box J19-14
40"SID	BLU/BLK/WHT	Cbl 5187.101.01 P19-14	Cbl 5187.101.01 J13-14
40"SID	BLU/BLK/WHT	Cbl 5187.101.011 P13-14	Tbst.OT Clm-DD
VERT SID SW	ORG/BLK/GRN	Aux Box CL TS4-16	Aux Box J19-15
VERT SID SW	ORG/BLK/GRN	Cbl 5187.101.01 P19-15	Cbl 5187.101.01 J13-15
VERT SID SW	ORG/BLK/GRN	Cbl 5187.101.011 P13-15	Tbst.OT Clm-U
TBL/R SID SW	RED/WHT	Aux Box CL TS4-15	Aux Box J19-16
TBL/R SID SW	RED/WHT	Cbl 5187.101.01 P19-16	Cbl 5187.101.011 J13-16
TBL/R SID SW	RED/WHT	Cbl 5187.101.011 P13-16	Tbst.OT Clm-Z
LG GND	ORG/GRN	Aux Box CL TS4-3	Aux Box J19-17
LG GND	ORG/GRN	Cbl 5187.101.01 P19-17	Cbl 5187.101.01 J13-17
LG GND	ORG/GRN	Cbl 5187.101.011 P13-17	Tbst.OT Clm-H
LG GND	BLK/WHT	Aux Box CL TS4-3	Aux Box J19-18
LG GND	BLK/WHT	Cbl 5187.101.01 P19-18	Cbl 5187.101.01 J13-18
LG GND	BLK/WHT	Cbl 5187.101.011 P13-18	Tbst.OT Clm-H
+15V	BLK	Aux Box CL TS4-20	Aux Box J19-19,20
+15V	BLK	Cbl 5187.101.01 P19-19	Cbl 5187.101.01 J13-19,20
+15V	BLK	Cbl 5187.101.011 P13-19	Tbst.OT Clm-A

2.6 COLLIMATOR LOGIC CABLE (continued)

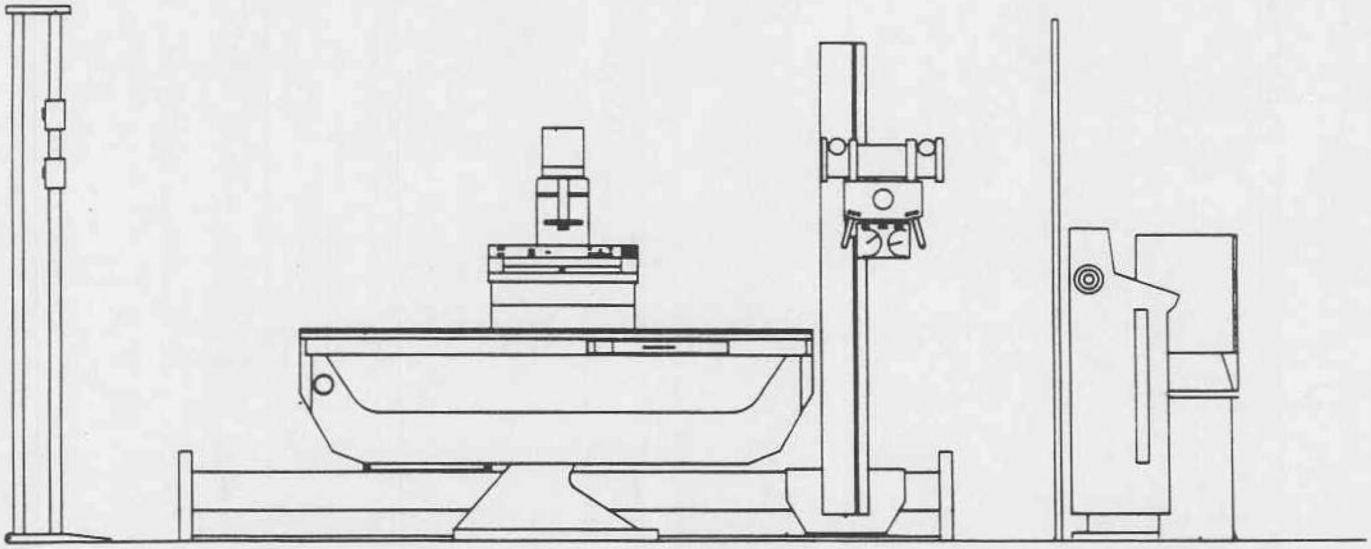
SIGNAL NAME	WIRE COLOR	FROM	TO
EXP/ REL/RY	BLK/RED/GRN	Aux Box CL TS4-8	Aux Box J19-21
EXP/ REL/RY	BLK/RED/GRN	Cbl 5187.101.01 P19-21	Cbl 5187.101.01 J13-21
EXP/ REL/RY	BLK/RED/GRN	Cbl 5187.101.011 P13-21	Tbst.OT Clm-CC
C=-90/T=-90	BLU	Aux Box CL TS3-8	Aux Box J19-22
C=-90/T=-90	BLU	Cbl 5187.101.01 P19-22	Cbl 5187.101.01 J13-22
C=-90/T=-90	BLU	Cbl 5187.101.011 P13-22	Tbst.OT Clm-F
WALL/R SID SW	GRN/BLK/ORG	Aux Box CL TS4-19	Aux Box J19-23
WALL/R SID SW	GRN/BLK/ORG	Cbl 5187.101.01 P19-23	Cbl 5187.101.01 J13-23
WALL/R SID SW	GRN/BLK/ORG	Cbl 5187.101.011 P13-23	Tbst.OT Clm-EE
TILT C=0	BLU/WHT/ORG	Aux Box CL TS3-5	Aux Box J19-24
TILT C=0	BLU/WHT/ORG	Cbl 5187.101.01 P19-24	Cbl 5187.101.01 J13-24
TILT C=0	BLU/WHT/ORG	Cbl 5187.101.011 P13-24	Tbst.OT Clm-W
VSID/ OUT	BLK/WHT/ORG	Aux Box CL TS3-4	Aux Box J19-25
VSID/ OUT	BLK/WHT/ORG	Cbl 5187.101.01 P19-25	Cbl 5187.101.01 J13-25
VSID/ OUT	BLK/WHT/ORG	Cbl 5187.101.011 P13-25	Tbst.OT Clm-FF
VIRL	GRN/BLK	Aux Box CL TS4-7	Aux Box J19-26
VIRL	GRN/BLK	Cbl 5187.101.01 P19-26	Cbl 5187.101.01 J13-26
VIRL	GRN/BLK	Cbl 5187.101.011 P13-26	Tbst.OT Clm-M
SHLD	SHLD	Aux Box CL	Aux Box J19-28
SHLD	SHLD	Cbl 5187.101.01 P19-28	Cbl 5187.101.01 J13-28
SHLD	SHLD	Cbl 5187.101.011 P13-28	Tbst.OT Clm

2.6 COLLIMATOR LOGIC CABLE (continued)

SIGNAL NAME	WIRE COLOR	FROM	TO
28VDC	ORG/BLK/WHT	Aux Box CL TS3-2	Aux Box J19-29
28VDC	ORG/BLK/WHT	Cbl 5187.101.01 P19-29	Cbl 5187.101.01 J13-29
28VDC	ORG/BLK/WHT	Cbl 5187.101.011 P13-29	Tbst.OT Clm-JJ
27VAC	WHT/RED/BLU	Aux Box CL TS3-1	Aux Box J19-30
27VAC	WHT/RED/BLU	Cbl 5187.101.01 P19-30	Cbl 5187.101.01 J13-30
27VAC	WHT/RED/BLU	Cbl 5187.101.011 P13-30	Tbst.OT Clm-PP
27VAC	WHT/BLK/GRN	Aux Box CL TS3-1	Aux BOX J19-31
27VAC	WHT/BLK/GRN	Cbl 5187.101.01 P13-31	Cbl 5187.101.01 J13-31
27VAC	WHT/BLK/GRN	Cbl 5187.101.011 P13-31	Tbst.OT Clm-RR
27VAC	RED/BLK/GRN	Aux Box CL TS3-1	Aux Box J19-32
27VAC	RED/BLK/GRN	Cbl 5187.101.01 P19-32	Cbl 5187.101.01 J13-32
27VAC	RED/BLK/GRN	Cbl 5187.101.011 P13-32	Tbst.OT Clm-SS
27VAC	BLK/WHT/GRN	Aux Box CL TS3-1	Aux Box J19-33
27VAC	BLK/WHT/GRN	Cbl 5187.101.01 P19-33	Cbl 5187.101.01 J13-33
27VAC	BLK/WHT/GRN	Cbl 5187.101.011 P13-33	Tbst.OT Tlm-TT
0VAC	BLK/WHT/RED	Aux Box CL TS4-1	Aux Box J19-34
0VAC	BLK/WHT/RED	Cbl 5187.101.01 P19-34	Cbl 5187.101.01 J13-34
0VAC	BLK/WHT/RED	Cbl 5187.101.011 P13-34	Tbst.OT Clm-KK
0VAC	RED/BLK/WHT	Aux Box CL TS4-1	Aux Box J19-35
0VAC	RED/BLK/WHT	Cbl 5187.101.01 P19-35	Cbl 5187.101.01 J13-35
0VAC	RED/BLK/WHT	Cbl 5187.101.011 P13-35	Tbst.OT Clm-LL
0VAC	WHT/RED/BLK	Aux Box CL TS4-1	Aux Box J19-36
0VAC	WHT/RED/BKL	Cbl 5187.101.01 P19-36	Cbl 5187.101.01 J13-36
0VAC	WHT/RED/BLK	Cbl 5187.101.011 P13-36	Tbst.OT Clm-MM
0VAC	WHT/RED/GRN	Aux Box CL TS4-1	Aux Box J19-37
0VAC	WHT/RED/GRN	Cbl 5187.101.01 P19-37	Cbl 5187.101.01 J13-37
0VAC	WHT/RED GRN	Cbl 5187.101.011 P13-37	Tbst.OT Clm-NN

CHAPTER 5

OPERATION



CHAPTER 5 - OPERATION

TABLE OF CONTENTS

SECTION NUMBER	DESCRIPTION	PAGE NUMBER
SECTION 1 - INTRODUCTION		1-1
1.1	GENERAL	1-1
1.2	SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES	1-1
1.3	MAXIMUM PERMISSIBLE DOSE	1-2
1.4	CDRH COMPLIANCE	1-2
SECTION 2 - CONTROLS AND INDICATORS		2-1
2.1	INTRODUCTION	2-1
2.2	MXR-350 GENERATOR MAIN PANEL CONTROLS	2-1
2.2.1	FLUOROSCOPIC CONTROLS	2-1
2.2.2	RADIOGRAPHIC (X-RAY) CONTROLS	2-1
2.2.3	METERS	2-6
2.3	SPOT FILM DEVICE	2-7
2.4	TABLE CONTROLS	2-15
2.5	TUBESTAND AND RADIOGRAPHIC COLLIMATOR	2-17
2.6	IMAGING SYSTEM	2-20
2.7	SYSTEM ACCESSORIES	2-21
SECTION 3 - DAILY PRE-OPERATIONAL SYSTEM CHECK		3-1
3.1	INTRODUCTION	3-1
3.2	DAILY PRE-OPERATIONAL SYSTEM CHECK	3-1
SECTION 4 - OPERATING PROCEDURES		4-1
4.1	INTRODUCTION	4-1
4.2	POWER APPLICATION	4-1
4.3	RADIOGRAPHIC PROCEDURES	4-1
4.4	FLUOROSCOPIC PROCEDURE	4-2
4.5	FLUOROSCOPY WITH SPOT FILM PROCEDURE	4-4
SECTION 5 - BIOLOGICAL EFFECTS OF RADIATION		5-1
5.1	GENERAL	5-1

TABLE OF CONTENTS (continued)

SECTION NUMBER — **DESCRIPTION** — **PAGE NUMBER**

SECTION 6 - RADIOGRAPHIC TECHNIQUES FOR THE AVERAGE LABORATORY 6-1

6.1 INTRODUCTION 6-1
6.2 BASIC TECHNIQUES 6-1
6.3 USING THE CHART 6-1
6.4 SUPPLEMENTAL INFORMATION 6-3

SECTION 7 - OPERATOR MAINTENANCE 7-1

7.1 INTRODUCTION 7-1
7.2 SYSTEM INSPECTION 7-1

SECTION 8 - SYSTEM CLEANING INSTRUCTIONS 8-1

8.1 GENERAL 8-1
8.2 IMAGE INTENSIFIER CLEANING 8-1
8.3 TUBESTAND 8-1

SECTION 9 - STORAGE INFORMATION 9-1

9.1 GENERAL 9-1
9.2 STORAGE INFORMATION OF SPOT FILM DEVICE 9-1
9.3 STORAGE INFORMATION OF IMAGE INTENSIFIER 9-2

LIST OF FIGURES

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
1-1	CS-8952 X-RAY SYSTEM	1-3
1-2	HARD WALL SHELTER CONFIGURATION	1-4
1-3	A TYPICAL HOSPITAL CONFIGURATION	1-5
2-1	GENERATOR MAIN CONTROL PANEL	2-2
2-2	SPOT FILM FRONT CONTROL PANEL	2-8
2-3	SPOT FILM DEVICE SELECTED DISPLAY	2-14
2-4	TABLE CONTROL PANEL	2-16
2-5	TUBESTAND AND COLLIMATOR CONTROLS	2-19
2-6	IMAGING SYSTEM	2-20
2-7	FOOT REST	2-26
2-8	SHOULDER REST	2-27
2-9	PATIENT HAND GRIPS	2-28
2-10	COMPRESSION BAND	2-29
2-11	UROLOGICAL KNEE CRUTCHES	2-30
2-12	HEAD HOLDER	2-31
2-13	LATERAL CASSETTE HOLDER	2-32
2-14	PATIENT FOOTSTEP	2-33
2-15	MOBILE GRID/CASSETTE/HOLDER	2-34
2-16	CASSETTE SENSING TRAY	2-35

LIST OF TABLES

TABLE NUMBER	DESCRIPTION	PAGE NUMBER
5-1	RESULTS OF WHOLE BODY EXPOSURE TO X-RADIATION	5-2
5-2	ESTIMATED DOSES FOR VARYING DEGREES OF INJURY	5-3
6-1	BASIC TECHNIQUES	6-2
6-2	GRID CONVERSION FACTORS	6-4
6-3	APPROXIMATE ANATOMICAL KVP RANGES	6-5

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SECTION 1 - INTRODUCTION

1.1 GENERAL

This text provides the operator with a system overview, and describes the purpose and function of the operating controls and indicators.

The CS-8952 Field Deployable Radiographic/Fluoroscopic X-ray System utilizes two x-ray tubes to provide radiographic, image intensified fluoroscopic, and spot film capabilities. The x-ray system is capable of long time exposures of 5 mA at 150 kVp and momentary exposures of 300 mA at 150 kVp.

The system consists of the MXR-350 X-ray Generator, MXT-90/15 X-ray Table and Under-Table Collimator, CTC Tubestand and Over-Table Collimator, EXT-950 Spot Film Device, I-7802 6-Inch Image Intensifier with Mirror Viewer, Radiation Shield, and a Mobile Cassette Holder. The under-table x-ray tube has focal spots of 0.6 and 1.2, 12° target angle and 0° arm angle. The over-table x-ray tube has focal spots of 1.0 and 2.0, a 16° target angle and a 90° arm angle. Also included are Box A and Box B breaker panels for in coming power. The major system components are illustrated in FIGURE 1-1. The components are designed for three (3) installation configurations; in a hard wall shelter (FIGURE 1-2), a typical hospital environment (FIGURE 1-3), and in field expedient surroundings.

1.2 SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES

One of the most important considerations in x-ray work is protection against the hazards of x-ray radiation. The x-ray equipment itself does not pose any danger but careless and improper usage does. It is essential that all operator and service personnel be properly informed on this matter. Those responsible for the operation of this x-ray equipment must fully understand the dangers, be familiar with the characteristics of x-ray radiation, and become thoroughly acquainted with the instructions in this manual.

The following guidelines have been laid down for personal safety:

1. Never expose a human for demonstration purposes only.

2. Never remain in a radiographic room while an exposure is in progress. Approximately 0.1% of the useful beam is scattered perpendicular to the beam at a distance of 1 meter from the patient.

3. Patients should rarely be restrained for radiography. Many efficient devices are available to achieve the required results, in addition to the technologists ingenuity.

1.2 SAFETY RECOMMENDATIONS AND BASIC SAFETY RULES (continued)

4. If a patient must be held, it should be done by a person not habitually exposed to ionizing radiation, whenever possible. In any case, this person must be protected by a lead apron and lead gloves.

5. Use an appropriate personnel film badge monitoring service and insist that all personnel are assigned a film badge, and wear them correctly.

6. During fluoroscopy, wear a protective apron, and when not actually assisting, stand in the control booth or behind the radiologist.

7. Periodically check protective aprons and gloves for cracks by a radiographic test using intensifying screens and exposure factors of 100 kVp, 10 mAs at a 100 cm (40-inch) focus-to-film distance.

1.3 MAXIMUM PERMISSIBLE DOSE

Many studies of the effects of x-ray radiation have been done to determine a "Maximum Permissible Dose". Conclusive evidence of what is a safe amount of radiation has remained elusive.

A safe rule to follow is "As Low As Reasonably Achievable" (ALARA). Always take all reasonable precautions to reduce radiation exposure as much as possible to patients, physicians, technicians, etc. at all times.

1.4 CDRH COMPLIANCE

All components of the x-ray system conform to the applicable requirements of the Center for Devices and Radiological Health (CDRH), Department of Health and Human Services, 21 CFR, Chapter 1, Subchapter J, at the time of manufacture.

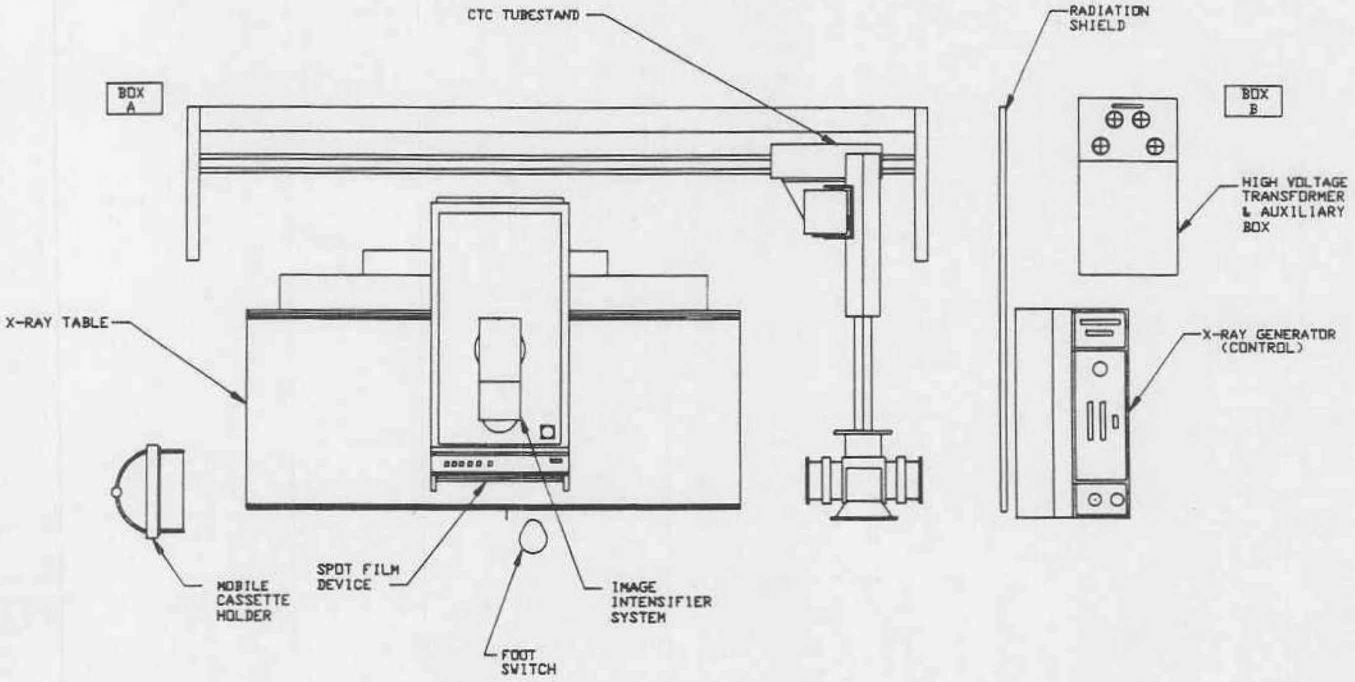
CTC TUBESTAND
RADIATION SHIELD
BOX A
BOX B
HIGH VOLTAGE TRANSFORMER & AUXILIARY BOX
X-RAY TABLE
X-RAY GENERATOR (CONTROL)
MOBILE CASSETTE HOLDER
SPOT FILM DEVICE
IMAGE INTENSIFIER SYSTEM
FOOT SWITCH

FIGURE 1-1 CS-8952 X-RAY SYSTEM

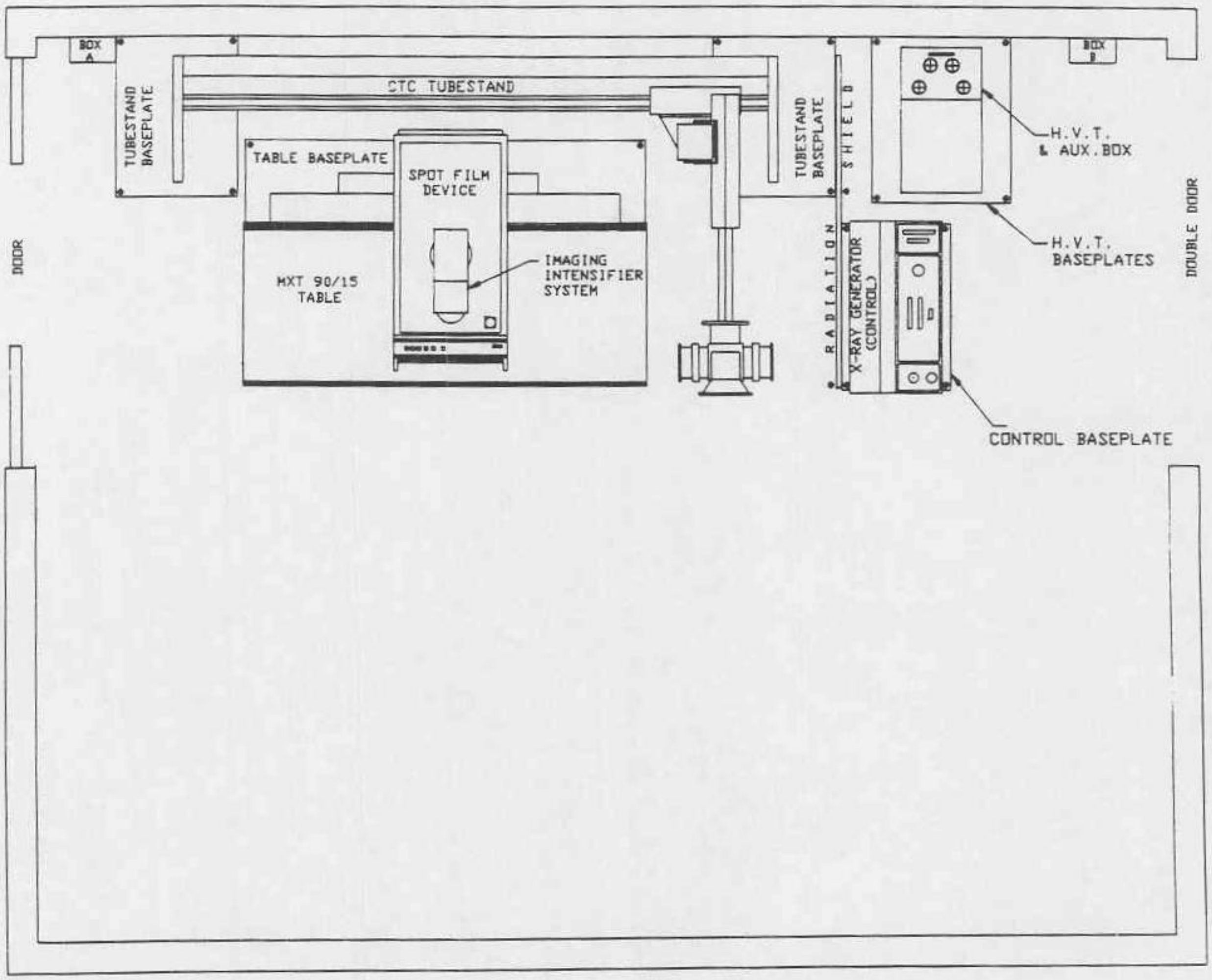
BOX A
TUBESTAND BASEPLATE
CTC TUBESTAND
TABLE BASEPLATE
SPOT FILM DEVICE
IMAGING INTENSIFIER SYSTEM
MXT 90/15 TABLE
DOOR
TUBESTAND BASEPLATE
RADIATION SHIELD
X-RAY GENERATOR (CONTROL)
H.V.T. & AUX. BOX
H.V.T. BASEPLATES
BOX B
DOUBLE DOOR
CONTROL BASEPLATE

FIGURE 1-2 HARD WALL SHELTER CONFIGURATION

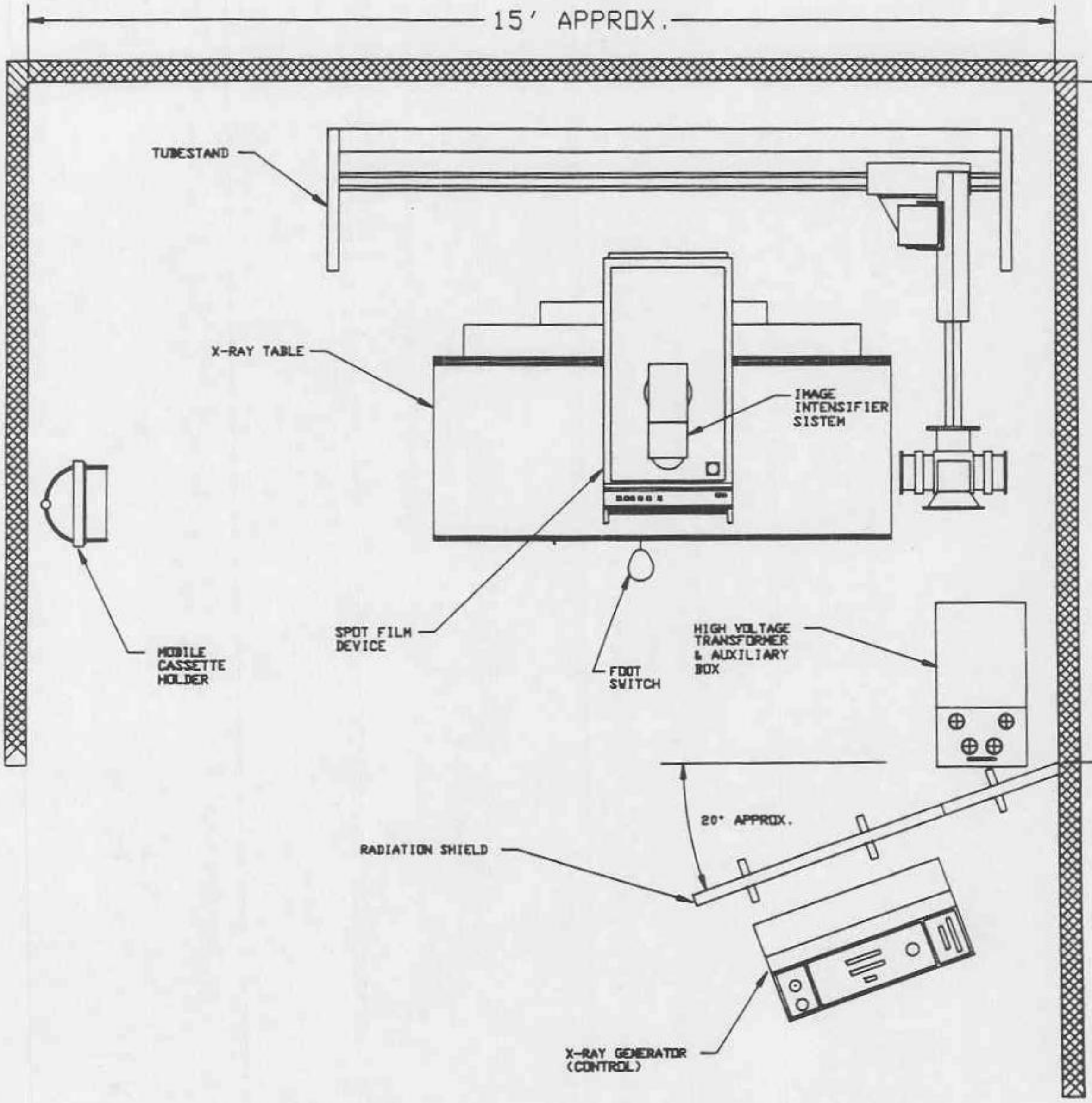
15' APPROX.
TUBESTAND
X-RAY TABLE
IMAGE INTENSIFIER SISTEM
10' MAXIMUM
MOBILE CASSETTE HOLDER
SPOT FILM DEVICE
FOOT SWITCH
HIGH VOLTAGE TRANSFORMER & AUXILIARY BOX
20° APPROX.
RADIATION SHIELD
X-RAY GENERATOR (CONTROL)

FIGURE 1-3 A TYPICAL HOSPITAL CONFIGURATION

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SECTION 2 - CONTROLS AND INDICATORS

2.1 INTRODUCTION

This section describes the operating controls and indicators of each system component.

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (FIGURE 2-1)

All MXR-350 operator controls are located on the front of the main control. Most of these controls are located on the main panel and are grouped according to function. The remaining controls are located directly below the main panel on the front of the unit.

The meter panel is located directly above the main panel on the front of the main control. The meters on this panel enable the operator to monitor the main control operating conditions and status.

Some of the main panel controls are rotary switches that provide the operator with several selections. Most of the controls on the main section of the front panel are push button switches. Some of them are alternate action push buttons while others must be pressed and held. They all light to indicate that the functions they control are active. On an alternate action push button, the second pressing deactivates its function and extinguishes its light.

2.2.1 FLUOROSCOPIC CONTROLS - Fluoroscopy is frequently initiated from a remote table footswitch. The factors governing the exposure are set at the generator front panel by means of two (2) controls:

MILLIAMPERES - (A in FIGURE 2-1) The milliamperes control enables the operator to select any one of five (5) tube current values (A, B, C, D, E) during fluoroscopy. The preselected values depend on the radiation output of the x-ray tube and are between 0.5 and 5 milliamperes.

MINUTES - (B in FIGURE 2-1) Limits the length of the fluoroscopic exposure. This control allows the operator to make multiple fluoroscopic exposures of up to five (5) minutes total duration.

This control must be manually reset.

2.2.2 RADIOGRAPHIC (X-RAY) CONTROLS

MAINS - (C in FIGURE 2-1) Pressing the MAINS push button switch applies power to the generator. Pressing it a second time turns power off.

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FIGURE 2-1 GENERATOR MAIN CONTROL PANEL

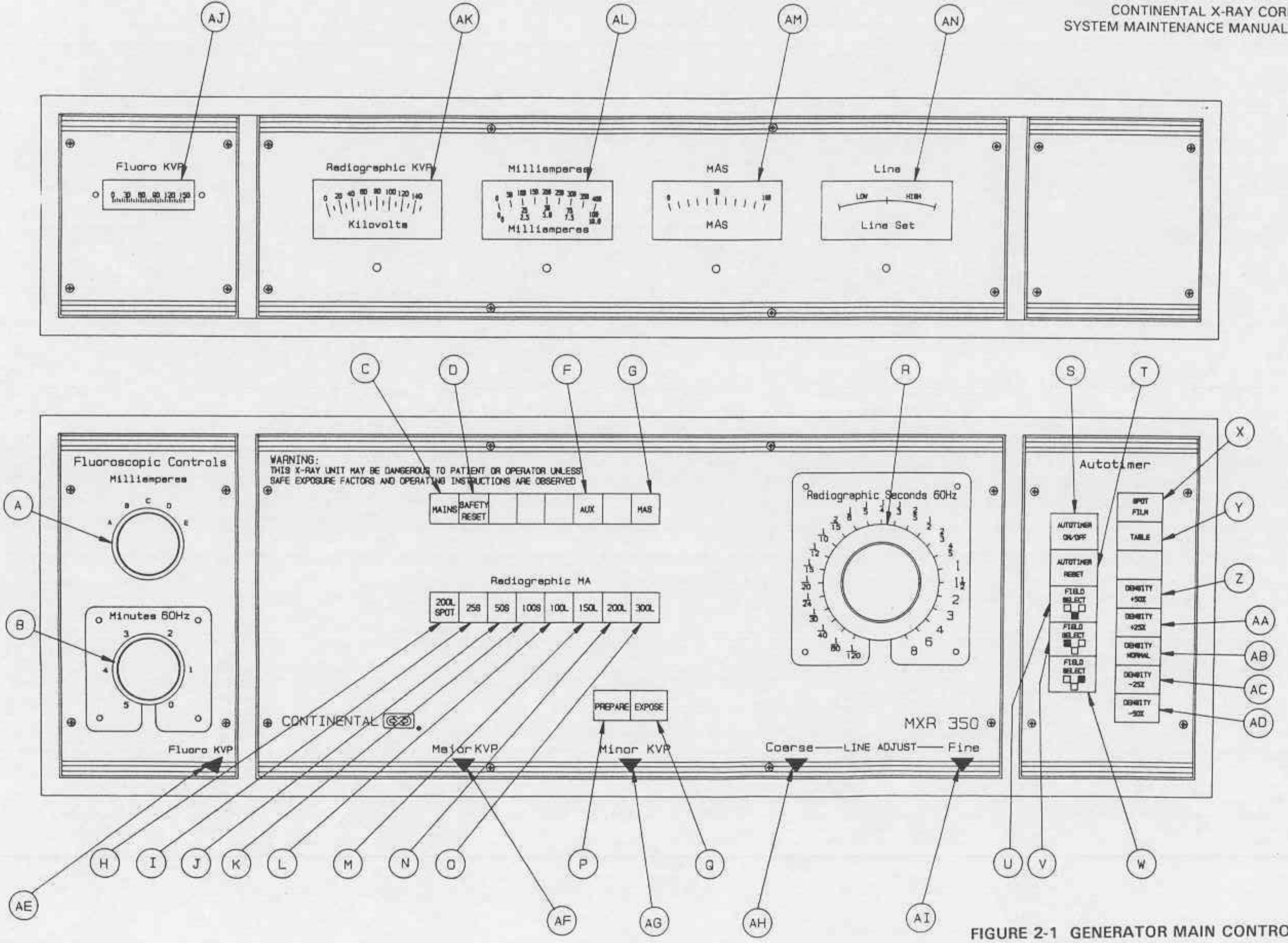

AJ
AK
AL
AM
AN
Fluoro KVP
Radiographic KVP
Kilovolts
Milliamperes
Milliamperes
MAS
MAS
Line
LOW
HIGH
Line Set
C
D
F
G
R
S
T
X
Y
Z
AA
AB
AC
AD
A
B
Fluoroscopic Controls
Milliamperes
A
B
C
D
E
Minutes 60Hz
Fluoro KVP
WARNING:
THIS X-RAY UNIT MAY BE DANGEROUS TO PATIENT OR OPERATOR UNLESS
SAFE EXPOSURE FACTORS AND OPERATING INSTRUCTIONS ARE OBSERVED
MAINS
SAFETY RESET
AUX
MAS
Radiographic MA
200L SPOT
25S
50S
100S
100L
150L
200L
300L
CONTINENTAL
PREPARE
EXPOSE
Major KVP
Minor KVP
Radiographic Seconds 60Hz
Coarse
LINE ADJUST
Fine
MXR 350
Autotimer
AUTOTIMER ON/OFF
AUTOTIMER RESET
FIELD SELECT
FIELD SELECT
FIELD SELECT
SPOT FILM
TABLE
DENSITY +50%
DENSITY +25%
DENSITY NORMAL
DENSITY -25%
DENSITY -50%
AE
H
I
J
K
L
M
N
O
P
Q
AF
AG
AH
AI
U
V
W

FIGURE 2-1 GENERATOR MAIN CONTROL PANEL

9086

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (continued)

SAFETY RESET - (D in FIGURE 2-1) Serves as both an indicator and a control. As an indicator, it lights to indicate that the generator is disabled because a technique that would damage the x-ray tube in use has been selected or that a generator fault has occurred.

When the SAFETY RESET light illuminates, it prevents further radiographic exposures. If an improper technique has been selected, selecting a proper one will extinguish the SAFETY RESET light. If the SAFETY RESET light was energized during a previous exposure due to a fault condition (excessive mA, gassy x-ray tube, or transformer failure), the SAFETY RESET can be cleared by depressing the switch.

The operator should be aware that the radiograph being taken when the fault occurred will probably be under-exposed due to early termination by the fault condition. If the SAFETY RESET repeatedly illuminates because of a fault condition, service is required to diagnose and correct the specific cause of the fault.

To the right of the SAFETY RESET button are three (3) blank, unused buttons.

The next button, F in FIGURE 2-1, is marked AUX. This button is unused at this time. To the right of this button is one (1) additional blank button, also unused at this time.

MAS - (G in FIGURE 2-1) Pressing and holding the MAS push button, connects the mAs meter (AM in FIGURE 2-1) into the generator circuitry. This enables the meter to display the true mAs value for the selected exposure factors. Releasing the push button disables the mAs meter. mAs meter will continue to read as long as the mAs push button is depressed.

RADIOGRAPHIC MA - (H through O in FIGURE 2-1) The radiographic mA group of switches selects tube current and focal spot size. Except for 200L SPOT (H in FIGURE 2-1), all switches select the over-table tube, currents, and focal spots.

Depressing the 200L SPOT push button selects 200 mA on the large focal spot of the under-table x-ray tube for spot film techniques. This switch also disables the PREPARE and EXPOSE switches (P and Q in FIGURE 2-1) so their functions can be activated from the spot film device control panel or the table footswitch.

Switches I, J and K in FIGURE 2-1 select 25 mA, 50 mA, or 100 mA, respectively, on the small focal spot of the over-table tube. Switches L, M, N and O in FIGURE 2-1 select 100 mA, 150 mA, 200 mA, or 300 mA on the large focal spot of the same x-ray tube.

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (continued)

PREPARE AND EXPOSE - (P and Q in FIGURE 2-1) The PREPARE switch prepares the over-table x-ray tube for making exposures by ensuring the tube rotor is up to speed and the filament voltage is at the proper level for the mA selected. This switch performs its function only while it is pressed.

PREPARE does not initiate radiographic exposures; it is used with the EXPOSE switch to make the exposure. PREPARE and EXPOSE must both be pressed and held together to make an exposure.

EXPOSE and PREPARE are disabled when the 200L SPOT switch (H in FIGURE 2-1) is pressed. This allows their functions to be actuated from the spot film device control panel or the table footswitch.

RADIOGRAPHIC SECONDS - (R in FIGURE 2-1) Radiographic (x-ray) exposure timing is determined by the setting of the radiographic seconds control. The generator uses the AC power frequency as the time base for producing the interval selected by this control.

Since the generator can operate from either 50 Hz or 60 Hz, different exposure intervals are available with each of these frequencies. A two-sided nameplate is supplied for this control. One side of this plate identifies the exposure intervals for 60 Hz, the other specifies them for 50 Hz.

RADIOGRAPHIC SECONDS - (60 HZ) When the generator is powered from a 60 Hz line, the control allows the operator to select exposure intervals of 1/120, 1/60, 1/40, 1/30, 1/24, 1/20, 1/15, 1/12, 1/10, 2/15, 1/6, 1/5, 1/4, 1/3, 2/5, 1/2, 2/3, 4/5, 1, 1-1/2, 2, 3, 4, 6, and 8 seconds.

RADIOGRAPHIC SECONDS - (50 HZ) A 50 Hz power line enables the operator to use the control to select 1/100, 1/50, 3/100, 1/25, 1/20, 3/50, 2/25, 1/10, 3/25, 3/20, 1/5, 1/4, 3/10, 2/5, 1/2, 3/5, 4/5, 1, 1-1/2, 2, 3, 4, 5, 6, and 8 seconds.

AUTOTIMER - The AUTOTIMER provides an appropriate exposure duration for many x-ray techniques. This will optimize the finished radiograph while minimizing the patient's radiation dose. The autotimer density controls enable the operator to further enhance the quality of the exposure.

AUTOTIMER ON/OFF - (S in FIGURE 2-1) Pressing the AUTOTIMER ON/OFF switch enables the autotiming function. Autotiming is disabled when the switch is pressed a second time.

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (continued)

AUTOTIMER RESET - (T in FIGURE 2-1) If an autotimed radiograph is terminated by the back-up timer instead of by the autotimer, the AUTOTIMER RESET button will light. Pressing the AUTOTIMER RESET button will reset the autotimer circuitry, while alerting the operator to a possible problem with the radiograph.

FIELD SELECT SWITCHES - (U, V and W in FIGURE 2-1) The autotimer can be controlled by any combination of the three fields in the table's ion chamber. Field select switches in conjunction with the TABLE push button (Y in FIGURE 2-1) enable the operator to select the desired active ion chamber fields.

SPOT FILM - (X in FIGURE 2-1) The x-ray system is equipped with a spot film device, which has its own ion chamber. Pressing the SPOT FILM control activates this ion chamber while deactivating all others. Since the spot film chamber has only one field, the field select switches have no effect when this chamber is selected.

TABLE - (Y in FIGURE 2-1) This push button activates the table's three-field ion chamber. It must be pressed before the field select switches (U, V and W in FIGURE 2-1) can select the active field(s) in the ion chamber.

DENSITY - (Z, AA, AB, AC and AD in FIGURE 2-1) These five (5) push buttons control film density (contrast). Exposures are ordinarily made with DENSITY NORMAL (AB in FIGURE 2-1). Exposures can be darkened by pressing DENSITY +25% (AA in FIGURE 2-1) or DENSITY +50% (Z in FIGURE 2-1) as required, with DENSITY +50% being darkest. Pressing DENSITY -25% (AC in FIGURE 2-1) lightens the exposure and DENSITY -50% (AD in FIGURE 2-1) lightens it further.

KVP AND LINE ADJUST CONTROLS - (AE, AF, AG, AH and AI) The kVp and line adjust controls are large knobs located below the main control front panel, on the front of the unit. These five (5) rotary knobs are easily accessible through an opening in the front of the cabinet and are used in conjunction with the fluoro kVp meter (AJ in FIGURE 2-1), radiographic kVp meter (AK in FIGURE 2-1), and line set meter (AN in FIGURE 2-1) above the main panel.

FLUORO KVP - (AE in FIGURE 2-1) The fluoro kVp is a continuously variable knob that allows for the selection of any kilovoltage between 50 kV and 125 kV when fluoroscopic exposures are being made.

MAJOR KVP (AF in FIGURE 2-1) and MINOR KVP (AG in FIGURE 2-1) Radiographic high voltage can be set to kilovoltages between 40 kVp and 150 kVp in 1 kVp steps by means of the major kVp and minor kVp knobs. Rotating the major kVp knob changes the kilovoltage in detent steps of approximately 10 kVp each. The minor kVp knob changes by approximately 1 kVp steps. These knobs must be positioned correctly on a discrete step.

2.2 MXR-350 GENERATOR MAIN PANEL CONTROLS (continued)

COARSE LINE ADJUST (AH in FIGURE 2-1) and FINE LINE ADJUST (AI in FIGURE 2-1) Coarse line adjust and fine line adjust are used together to compensate for variations in the line voltage.

2.2.3 METERS - The front panel meters allow the operator to monitor generator operations. Several of these analog meters are used in conjunction with controls already discussed.

FLUORO KVP METER - (AJ in FIGURE 2-1) The fluoro kVp meter displays the x-ray tube kilovoltage in the fluoroscopic mode, as set by the fluoro kVp control (AE in FIGURE 2-1).

RADIOGRAPHIC KVP METER - (AK in FIGURE 2-1) This meter displays the radiographic x-ray tube kVp as selected by the settings of major kVp knob (AF in FIGURE 2-1) and the minor kVp knob (AG in FIGURE 2-1).

MILLIAMPERES METER - (AL in FIGURE 2-1) The milliamperes meter displays the amount of current being drawn by the x-ray tube during exposures; the meter is not operational at other times.

MAS METER - (AM in FIGURE 2-1) This meter displays the mathematical product of tube current and exposure length. To activate, press the MAS push button (G in FIGURE 2-1) during exposure. The mAs meter resets to zero when the MAS button is released.

LINE SET METER - (AN in FIGURE 2-1) The line set meter indicates when the applied (line) voltage is correctly adjusted. Instead of a numerical scale, a reference mark indicates the center of the meter. When the voltage applied to the generator is correct, the meter points to this mark.

If the voltage is lower than normal, the meter points to the low side of the scale. If the voltage is higher than normal, the meter deflects toward the high end.

Input voltage, and the resulting meter deflection of the line set meter, is adjustable by rotating the coarse (AH) and fine (AI) line adjust controls as needed to position the pointer at the center reference mark.

2.3 SPOT FILM DEVICE (FIGURE 2-2)

Most of the controls on the spot film device front panel are alternate action push button switches. Some are for the spot film device, while others control making x-ray exposures, the collimator mode setting, positioning the table top, and setting or releasing spot film device locks. These switches light to indicate when they are active.

In addition to the push button controls, the front panel also has two slide controls, a rotary control, and a two-position, spring-loaded, center-off rotary switch. The front panel has an LED display to provide a visual indication of the spot film format selected. The LED display indicates certain errors, such as the cassette carriage is empty, all exposures have been made (the cassette is "full"), or the spot film device is not properly locked into position.

A power assist handle is on the front of the unit. This assists movement of the spot film device in the longitudinal direction only.

COLLIMATOR AND MODES OF OPERATION

COLLIMATOR - The under-table collimator works in conjunction with the spot film device. The collimator enables automatic regulation of the size of the radiation field to preset limits, according to the format selected and the source-to-image distance (SID).

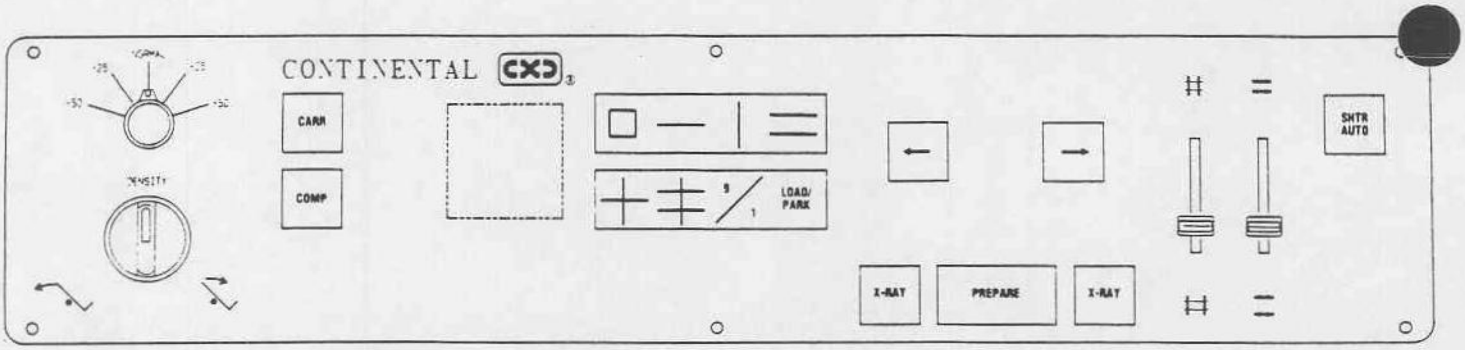
MODES OF OPERATION - The ability of the spot film device to control the under-table collimator is one of its most important characteristics. It exercises this control in three ways:

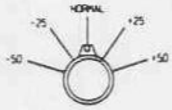
- automatic radiography (spot film)
- manual radiography (spot film)
- fluoroscopy.

The spot film device automatically sets the collimator shutters according to the format selected and its distance from the table when a spot film exposure is requested.

Control over the size of the collimator aperture is similar in the manual radiographic and fluoroscopic modes of operation. The operator has manual control over the collimator shutters by means of front-panel controls.

When taking spot films, aperture size cannot be increased beyond the preset frame size for the selected spot film format. When in fluoroscopy, the front panel controls allow the operator to vary the aperture from fully closed to fully opened, as determined by the size of the image intensifier.


CONTINENTAL CXD
-25
NORMAL
+25
-50
+50
DENSITY
CARR
COMP
9
1
LOAD/PARK
SHTR AUTO
X-RAY
PREPARE
X-RAY

A	CARR	TRANSVERSE AND LONGITUDINAL LOCKS (PUSH ON, PUSH OFF)
B	COMP	COMPRESSION LOCK (PUSH ON, PUSH OFF)
C		DENSITY CONTROL
D	SHTR AUTO	SHUTTER AUTO
E	X-RAY	X-RAY REQUEST FLUORO OR RADIOGRAPHIC WHEN IN PREPARE
F	PREPARE	PREPARE REQUEST

NORMAL
-25
+25
-50
+50

G_1		1 ON 1 FILM FORMAT
G_2		2 ON 1 FILM FORMAT
G_3		2 ON 1 FILM FORMAT
G_4		3 ON 1 FILM FORMAT
G_5		4 ON 1 FILM FORMAT
G_6		6 ON 1 FILM FORMAT
G_7	9/1	9 ON 1 FILM FORMAT
G_8		CASSETTE LOAD/PARK

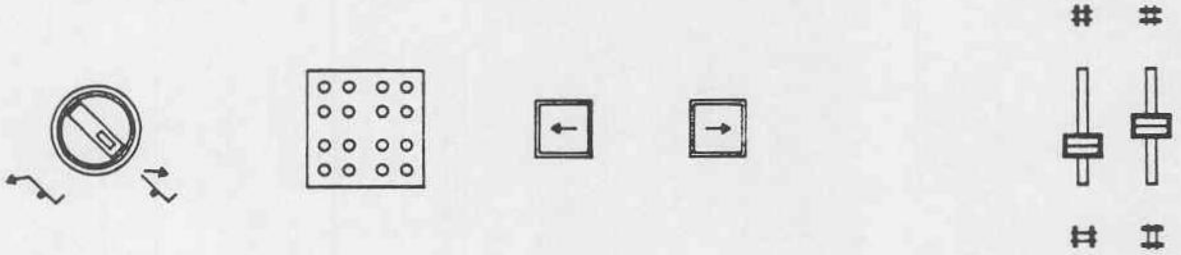


TABLE TILT CONTROL
H

FORMAT INDICATION (4 ON 1 FORMAT SHOWN)
I

TWO WAY TABLE TOP CONTROL
J

LONGITUDINAL MANUAL COLLIMATOR CONTROL
K

TRANSVERSE MANUAL COLLIMATOR CONTROL
L

FIGURE 2-2 SPOT FILM FRONT CONTROL PANEL

2.3 SPOT FILM DEVICE (continued)

CARR LOCKS - (Carriage Locks - A in FIGURE 2-2) Actuates the Carriage Locks. When switch A is pressed, its illumination increases to indicate that the transverse and longitudinal locks are engaged. Pressing it a second time decreases its light level while releasing the locks so the spot film device can be repositioned.

COMP LOCKS - (Compression Lock - B in FIGURE 2-2) When active, this lock prevents movement of the spot film device toward or away from the table. Pressing this switch engages the compression lock, and increases the light level of the switch. Pressing it again releases the lock, allowing the spot film device to be repositioned.

DENSITY - (C in FIGURE 2-2) This is a rotary control for setting the density of spot film exposures. Rotating this control to the right increases density. Rotating it to the left decreases it.

LED DISPLAY - (I in FIGURE 2-2, and FIGURE 2-3) The spot film device LEDs provide a visual representation of the spot film format selected. The display consists of 25 LEDs arranged in a five by five grid which light to form a pattern. The LEDs representing each frame in the selected format go out as the frame is exposed.

ERROR CODES - FIGURE 2-3 When the display looks like the letter "C", it indicates there is no cassette in the carriage, all exposures in the selected format have been made, or the cassette holder is empty in its forward position.

When the display looks like the letter "X", it indicates the spot film device is not locked in its forward position.

FORMAT SELECTION SWITCHES (G1-G7 in FIGURE 2-2) - The spot film device can make as many as nine (9) exposures on a film cassette using any one of seven (7) formats that can be selected before beginning an exposure sequence.

Double exposures are prevented by microprocessor controlled logic, and cassettes can be ejected at any time during the exposure sequence. This logic circuitry also automatically controls aperture size when the SHTR AUTO push button (D in FIGURE 2-2) is lit.

2.3 SPOT FILM DEVICE (continued)

- push button G1 selects the One-On-One Spot Film format
- push button G2 selects Two-On-One Longitudinal (head-foot)
- push button G3 selects Two-On-One Transverse (front-back)
- push button G4 selects Three-On-One
- push button G5 selects Four-On-One
- push button G6 selects Six-On-One
- push button G7 selects Nine-On-One

The light in each of these switches brightens when that format is selected.

PARK/LOAD - (G8 in FIGURE 2-2) Pressing switch "G8" causes the spot film device to load and park a cassette.

WARNING

NEVER INSERT A CASSETTE INTO THE FRONT PANEL SLOT BEFORE DETERMINING LOCATION OF CASSETTE TRAY.

The tray must be in the forward (load) position before a cassette is inserted. The operator should visually inspect the spot film device to ascertain the position of the cassette tray. After the exposures have been made and the cassette is parked, pressing this button again moves the cassette forward and out for ejection.

TABLE TOP MOTION CONTROLS - (J in FIGURE 2-2) These two momentary push button switches control table top longitudinal movement. As the arrows indicate, the switches of "J" move the table top toward the head end and toward the foot.

MANUAL COLLIMATOR CONTROLS AND AUTOMATIC COLLIMATION - (K, L, AND D in FIGURE 2-2) When the spot film device is in the radiographic (spot film) mode and the SHTR AUTO (automatic/manual) push button (D in FIGURE 2-2) has been pressed, "auto mode", automatically determines the collimator aperture size for all spot film formats.

Pressing SHTR AUTO a second time sets the spot film device to the manual mode. In this mode, the operator has control over the collimator aperture size with the use of controls "K" and "L" in FIGURE 2-2. Slide control "K" varies the opening of the head-foot (longitudinal) shutter blades and slide control "L" varies the opening of the front-back (transverse) blades. Both controls can be used together for simultaneous movement of the shutter blades. At no time can the shutter blades be open beyond the frame size of the selected format.

2.3 SPOT FILM DEVICE (continued)

Slide controls always operate the collimator aperture when the spot film device is in the fluoro mode of operation. When the system is in the radiographic mode, the collimator aperture cannot be increased beyond the frame size for the selected format. To close the shutters, slide the controls up; sliding the controls down opens them.

PREPARE AND X-RAY - (F AND E in FIGURE 2-2) Pressing the PREPARE switch causes the cassette to move from the rear (park/fluoro position) into position for the next unexposed frame in the selected format. Releasing the switch without also pressing X-RAY allows the cassette to return to the park/fluoro position without exposing the film or advancing the frame.

PREPARE must be pressed and held while making exposures.

PREPARE ensures that the x-ray tube rotor is up to speed, the filament voltage is at the proper level, unlocked locks are engaged, etc.

The PREPARE switch and one of the X-RAY switches (E in FIGURE 2-2) must be simultaneously pressed and held once for each exposure.

If it is necessary to interrupt a spot film sequence, the spot film device "knows" its location on a given cassette during any spot film sequence. It avoids double exposures by resuming with the next open frame after an interruption, provided that the cassette has not been ejected.

Pressing either X-RAY switch or the footswitch without pressing PREPARE, initiates a fluoroscopic exposure that continues until the initiating switch is released or the fluoro time expires.

TABLE TILTING - (H in FIGURE 2-2) Table tilting is under the control of the spring-loaded, two-position, center-off rotary switch at the lower left of the front panel. Rotating and holding this switch to the right causes the table to tilt to the right. When the switch is released, it returns to its center-off position and table movement stops.

Rotating the switch to the left causes the table to tilt to the left. Releasing the switch allows it to return to its center-off position and table movement stops.

This switch only activates the table tilting mechanism.

It does not affect the table's tilt speed or its maximum vertical or Trendelenburg positions. These are determined by its mechanism.

2.3 SPOT FILM DEVICE (continued)

SPOT FILM DEVICE POSITIONING - The table mounted spot film device carriage enables the operator to position the spot film device at any location over the patient in three (3) dimensions. The under-table x-ray tube and collimator are mechanically linked to the spot film device, both laterally and longitudinally, and will move along with the spot film device.

POWER ASSIST HANDLE - The power assist handle, located on the front of the spot film device, assists in longitudinal repositioning of the spot film device, under-table x-ray tube, and collimator. It also automatically disengages the longitudinal and transverse locks, if they are engaged, during spot film device movement.

A small amount of lateral pressure on the handle toward the left disengages the locks, if they are engaged (push button A in FIGURE 2-2 is brightly lit) and activates the Power Assist circuit. This moves the spot film device, tube and collimator toward the head end of the table until pressure is released.

If the locks are engaged, releasing the pressure stops carriage motion and re-engages them. If push button "A" is dimly lit (locks are not engaged), the spot film device carriage motion stops without re-engaging the locks.

Operation is similar for repositioning toward the foot end of the table when handle pressure is exerted to the right.

WARNING

THE VERTICAL (COMPRESSION) CARRIAGE ALLOWS THE CONE AND SPOT FILM DEVICE CHASSIS TO COME IN CONTACT WITH PATIENTS, AS IS NECESSARY FOR SOME PROCEDURES. IN OTHER PROCEDURES, SUCH AS MYELOGRAMS, CONTACT CAN BE DANGEROUS AND RESULT IN SERIOUS PATIENT INJURY.

IT IS VITAL THAT THE MYELOGRAPHIC STOP BE SET ON THE SPOT FILM DEVICE TOWER TO PREVENT THE SPOT FILM DEVICE AND/OR CONE FROM CONTACTING THE PATIENT WHEN THESE PROCEDURES ARE BEING PERFORMED.

2.3 SPOT FILM DEVICE (continued)

CASSETTE LOADING/UNLOADING - The spot film device accepts standard 9-1/2" X 9-1/2" (24 cm X 24 cm) cassettes through a slot directly below the power assist handle. Before loading in a new cassette, make certain the cassette receptacle is in its forward position.

WARNING

CASSETTE CAN "JAM" IF THE OPERATOR ATTEMPTS TO LOAD A CASSETTE WHEN THE CASSETTE RECEPTACLE IS NOT IN THE "LOAD" POSITION.

To ensure that the spot film device receptacle (carriage) is in the forward position:

1. position finger on the LOAD/PARK button (G8 in FIGURE 2-2)
2. while looking in the cassette opening, press the LOAD/PARK button
3. if the cassette receptacle moves forward, the spot film device is ready to accept a new cassette
4. if the cassette moved to the rear, press the button again, causing the cassette receptacle to move to the forward position.

Be sure that the cassette is face down (x-ray penetrable surface facing the under table x-ray tube) before gently inserting it into the slot as far as it will go.

The width of the carriage is fixed, making it easy to insert the cassette correctly. After the cassette is inserted, press the LOAD/PARK button to park it.

Unloading the cassette consists of momentarily pressing the LOAD/PARK button a second time. The carriage then moves the cassette forward and out, making it easy to remove the cassette.

1 ON 1

○○○○○
○●●●○
○●●●○
○●●●○
○○○○○

**2 ON 1
LONGITUDINAL**

●●●●●
●●●●●
○○○○○
●●●●●
●●●●●

**2 ON 1
TRANSVERSE**

●●○●●
●●○●●
●●○●●
●●○●●
●●○●●

3 ON 1

●●●●●
○○○○○
●●●●●
○○○○○
●●●●●

4 ON 1

●●○●●
●●○●●
○○○○○
●●○●●
●●○●●

6 ON 1

●○●○●
●○●○●
○○○○○
●○●○●
●○●○●

9 ON 1

●○●○●
○○○○○
●○●○●
○○○○○
●○●○●

**ERROR
CASSETTE**

●●●○○
●○○○○
●○○○○
●○○○○
●●●○○

**ERROR
X-RAY INTERLOCK**

●○○○●
○●○●○
○○●○○
○●○●○
●○○○●

ERROR CASSETTE - There is no cassette or the cassette is full.

ERROR X-RAY INTERLOCK - The spot device is not locked in the forward expose position.

FIGURE 2-3 SPOT FILM DEVICE SELECTED DISPLAY

2.4 TABLE CONTROLS - (FIGURE 2-4)

TABLE FRONT PANEL CONTROLS:

The table front panel is located at the head end of the table skirt. The panel consists of five (5) illuminated, single-action (press and hold) push button switches. Each switch lights to indicate that the motion it controls is active. Pressing any given switch initiates motion that continues until maximum placement is reached or the switch is released, whichever occurs first. The motions controlled by the switches are as follows:

TABLE TOP HEAD CONTROL - (switch A in FIGURE 2-4) Activates the table top movement longitudinally toward the head end. Maximum center-to-head displacement is 30" (762 mm).

TABLE TOP FOOT CONTROL - (switch B in FIGURE 2-4) Activates movement of the table top toward the foot end of the table. Maximum longitudinal travel is 30" (762 mm) center to foot.

TABLE TOP CENTER CONTROL - (switch C in FIGURE 2-4) Activates and centers the top, regardless of its previous head or foot end position.

TRENDELENBURG TILT CONTROL - (switch D in FIGURE 2-4) The table tilts toward a maximum Trendelenburg position of 12° at a rate of 4° per second when the push button is depressed.

VERTICAL TILT CONTROL - (switch E in FIGURE 2-4) When depressed, the table tilts toward the foot end up to a maximum of 88° at 4° per second.

ANGULATION GAUGE - The gravity-operated angulation gauge is mounted on the table skirt at the head end of the table above the footstep. The gauge rotates as the table is tilted. A slot in the table skirt at the top of the angulation gauge points to the angle of the table.

MYELOGRAPHIC STOP - A myelographic stop to limit the travel of the vertical carriage is located at the rear of the table on the table tower. To use this mechanical device, rock it upward and slide it to the desired position. It automatically locks when it is released.

TABLE FOOTSWITCH - The table has a two-stage footswitch for use with fluoroscopy and spot filming in conjunction with the spot film device. During fluoroscopy only, pressing hard on the footswitch activates the second stage, which raises the fluoro mA to the high level mode.

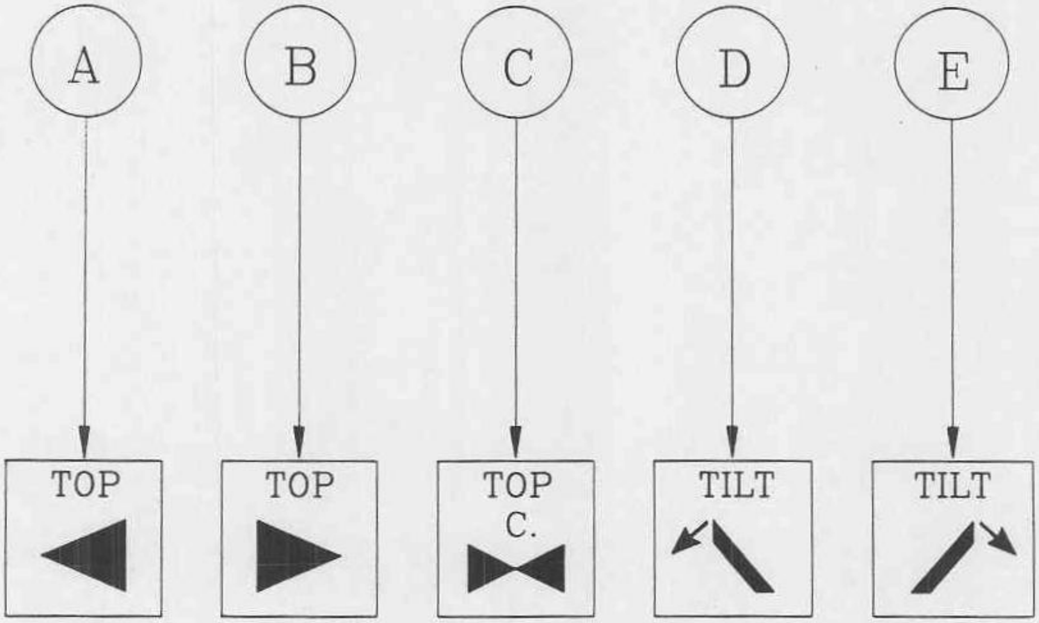

A
B
C
D
E
TOP
TOP
TOP
C.
TILT
TILT

FIGURE 2-4 TABLE CONTROL PANEL

2.5 TUBESTAND AND RADIOGRAPHIC COLLIMATOR - (FIGURE 2-5)

The tubestand is equipped with four (4) electromagnetic locks and two (2) mechanical locks. The electromagnetic locks are controlled by six (6) switches on the control panel and are always engaged until they are released by depressing the appropriate switch.

The tubestand control panel has switches for electric locks that control the tubestand vertical, lateral, lateral centering, and roll motions.

ELECTROMECHANICAL LOCKS - The tubestand uses electromechanical locks for all of its motions.

ROLL LOCK - (ROLL in FIGURE 2-5) When the ROLL switch is pressed, the x-ray tube can be manually rolled to any angle between 90° toward the head or foot end of the table, for total range of 180°. Releasing this push button switch locks the x-ray tube at the desired angle.

LONGITUDINAL LOCK - (LONG in FIGURE 2-5) Longitudinal travel of the tubestand is controlled by the LONG switch. When this switch is pressed, the lock releases and allows travel of the tubestand along the floor rail.

LATERAL LOCKS - (LAT and LAT CTR in FIGURE 2-5) The LAT switch controls the lateral travel of the tube carriage. Depressing the LAT CTR (Lateral Center) switch allows the lateral lock to be automatically applied when the x-ray tube focal spot crosses lateral center line of the table top, but released at all other times. To release the tube when it is locked at the lateral center line, press the LAT switch.

ALL - (ALL in FIGURE 2-5) Pressing the ALL push button switch simultaneously releases all locks except ROLL.

VERTICAL LOCK - (VERT in FIGURE 2-5) The VERT switch controls the travel of the vertical carriage on the column. This switch allows the operator to set the x-ray tube at the desired height. The vertical height scale, on the vertical column, allows the operator to determine the distance of the focal spot from the table top and the table grid cabinet.

MECHANICAL LOCKS

PITCH - (LOCATED ON RIGHT SIDE OF TUBESTAND CONTROL PANEL) Loosening the pitch lever allows manual transverse tilting of the tube head between 30° toward the table front and 20° toward the rear. Tightening the lever locks the head in the desired position.

2.5 TUBESTAND AND RADIOGRAPHIC COLLIMATOR (continued)

VERTICAL COLUMN ROTATION - The tubestand vertical column is capable of manual rotation through 360°. Its base is equipped with four (4) detents to hold it into position at:

- 0°/360° x-ray tube head directly over the table
- 90° x-ray tube head toward the head end
- 180° x-ray tube head directly away from the table top
- 270° x-ray tube head toward the foot end.

The tubestand may be mounted so close to a wall that its motion is restricted. The vertical column rotation is ordinarily from the table's head end to the foot end for a usable range of 180°.

Manual rotation of the tubestand is accomplished by applying enough force to overcome the resistance of a detent (if one is engaged) and turning the vertical column to the desired position.

RADIOGRAPHIC COLLIMATOR (FIGURE 2-5) The collimator limits the x-ray beam to the film size. The bottom of the collimator has grooves to allow a "beam-limiting" cone to be attached. The collimator controls are:

LAMP ON/OFF - Press the push button to start the timed light display. The light goes out after approximately 30 seconds. The light beam is focused off an internal mirror.

LONGITUDINAL SHUTTER ADJUSTMENT - Controls the longitudinal shutters.

TRANSVERSE SHUTTER ADJUSTMENT - Controls the transverse shutters.

MIRROR RETRACTOR - Allows operator to move the light-beam mirror out of the way to allow visual inspection of the x-ray tube. The retractor switch is a small circular opening on the bottom of the collimator. Activate with a small screw driver.

WARNING

DO NOT LOOK DIRECTLY AT THE X-RAY TUBE WHILE ON!

2.5 TUBESTAND AND RADIOGRAPHIC COLLIMATOR (continued)

SOURCE-IMAGE DISTANCE (SID) SCALE - Sliding the knob positions the scale at detents of 40" or 72", indicating field coverage at these SID's.

SID INDICATORS - Indicating lamps that correspond to vertical and horizontal SID's.

EXPOSURE HOLD INDICATOR - Indicates the shutters are not properly positioned, vertical SID is not positioned at 40", or the horizontal SID is not positioned at standard SID's.

MANUAL INDICATOR - Indicates the collimator or table is tilted greater than 10° away from vertical or horizontal, cassette is not located in the cassette tray, or cassette tray is not fully inserted in the carrier.

READY INDICATOR - Indicates the shutters are properly positioned.

TAPE MEASURE - On the bottom of the right side of the collimator is a "pull-down" tape measure, to facilitate measuring SID.

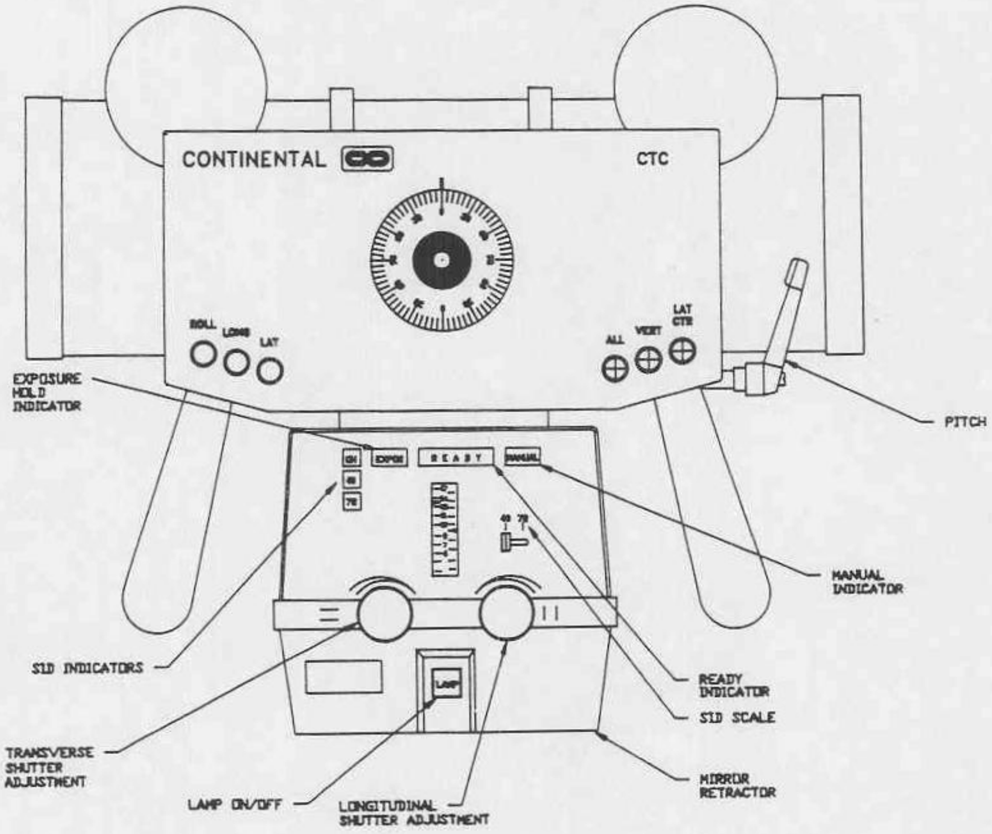

CONTINENTAL
CTC
ROLL
LONG
LAT
ALL
VERT
LAT CTR
EXPOSURE HOLD INDICATOR
PITCH
EXPOS
READY
MANUAL
40
72
MANUAL INDICATOR
SID INDICATORS
LAMP
READY INDICATOR
SID SCALE
TRANSVERSE SHUTTER ADJUSTMENT
MIRROR RETRACTOR
LAMP ON/OFF
LONGITUDINAL SHUTTER ADJUSTMENT

FIGURE 2-5 TUBESTAND AND COLLIMATOR CONTROLS

2.6 IMAGING SYSTEM - (FIGURE 2-6)

The fluoroscopic image is viewed by means of a mirror. Most of the system's operation is automatic, requiring a minimum of operator control. Angulation and height adjustments enable the user to position the mirror for comfort and optimum viewing.

To adjust the angle of the mirror, grasp it by the protruding edge and tilt it to the desired angle.

Mirror height is adjusted by using its bottom bracket to raise or lower it to the desired height. An adjustment screw with locking nut is installed on the rear of the height adjustment bracket for controlling the amount of force needed to reposition the mirror.

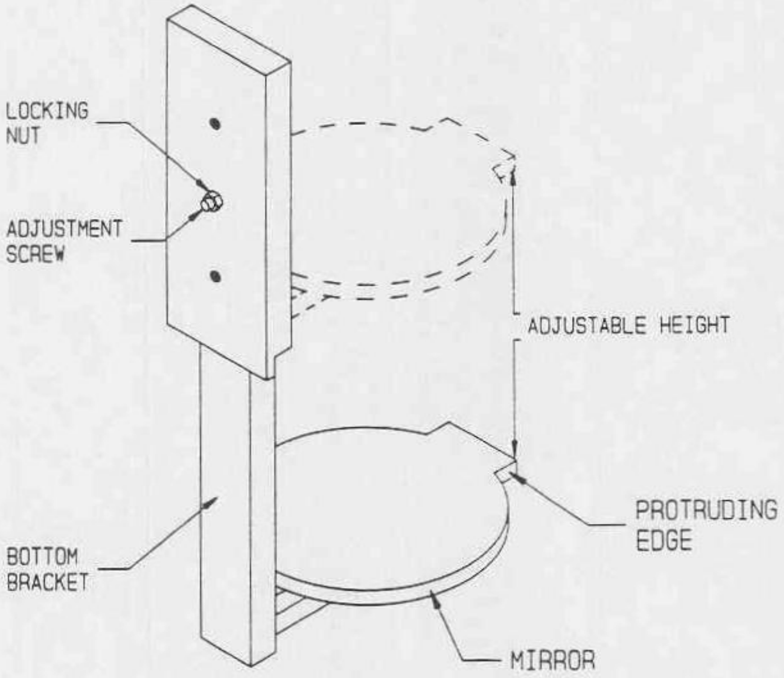

LOCKING NUT
ADJUSTMENT SCREW
ADJUSTABLE HEIGHT
PROTRUDING EDGE
BOTTOM BRACKET
MIRROR

FIGURE 2-6 IMAGING SYSTEM

2.7 SYSTEM ACCESSORIES - (FIGURES 2-7 through 2-16)

A full complement of easily attachable and removable accessories is supplied with the MXT-90/15 Table. This section describes the placement and use of these accessories.

FOOT REST (FIGURE 2-7) - two (2) spring-loaded latches with hand grips hold the foot rest on the table. Squeezing the hand grips against the handles releases the latches so that the foot rest can be attached on or removed from the table top. To attach the foot rest:

1. Stand at the foot of the table and hold the foot rest by the hand grips.

2. Squeeze both hand grips against the handles while sliding the foot rest onto the foot end of the table top.

3. Position the foot rest over the desired notch pairs in the table top edges and release the hand grips.

4. Be certain that the foot rest is firmly seated on the table before allowing patients to use.

To remove the foot rest, squeeze the latch release hand grips until the latches disengage from the notches and slide it from the table.

SHOULDER REST (FIGURE 2-8) - The shoulder rest is equipped with the same kind of handles and latch releases as the foot rest and attaches to the table in the same way. The shoulder rest is ordinarily attached at the head end. To attach the shoulder rest to the table:

1. Hold the shoulder rest by the handles with the shoulder pads toward the table.

2. Squeeze both latch release hand grips against the handles and slide the shoulder rest onto the table top from the head end.

3. Position the shoulder rest over the desired notch pairs in the table top edges and release the hand grips. If an adjustment is needed for the latches to engage the desired notches, slide the shoulder rest in the appropriate direction until the latches engage.

4. The shoulder pads are independently adjustable. Adjust them by loosening the knurled adjusting knobs and setting them to the desired position. To remove the shoulder rest, squeeze the latch release hand grips until the latches disengage from the notches and slide it from the table.

2.7 SYSTEM ACCESSORIES (continued)

PATIENT HAND GRIPS (FIGURE 2-9) - The two (2) hand grips can be independently clamped at any location along the length of the table top. To attach the hand grips, press the release latch and place the hand grip in the released position. Turn the lock knob fully counterclockwise. Slide the hand grip clamp onto the edge of the table top. Position it at the desired location and place the handle in the lock position. Secure the hand grip to the table top by turning the lock knob clockwise.

Repeat above steps to install the remaining hand grip. Once they are attached, the position of the hand grips can be adjusted by loosening their clamps and sliding them to the new location.

WARNING

FOR PATIENT SAFETY, ALWAYS BE SURE THAT THE HAND GRIPS ARE FIRMLY CLAMPED TO THE TABLE TOP.

To remove hand grips, complete the above procedure in reverse.

COMPRESSION BAND (FIGURE 2-10) - The compression band consists of two (2) parts; the back assembly and the ratchet assembly. The back assembly secures one end of the compression band. The ratchet assembly is used to tighten the band after it is positioned over the patient and secured to the back assembly. The compression band is stored on the ratchet assembly when not in use.

Both assemblies are attached to the table by means of a clamping arrangement that is functionally identical to those used on other accessories. To attach and use the compression band:

1. Slide the back assembly onto the rear edge of the top from the foot end of the table.

2. Position the back assembly at the desired location.

3. Slide the ratchet assembly along the table top front edge until it is directly opposite the back assembly and secure in position by turning the two (2) knurled tightening knobs clockwise.

4. Grasp the compression belt by the end and stretch it over the patient. The free end of the belt is fitted with a metal rod having grooves at the ends. The compression belt is secured by engaging these grooves with the hooks on each side of the back assembly.

2.7 SYSTEM ACCESSORIES (continued)

5. Tighten the compression belt by pulling on the compression knob while turning it until the desired compression is achieved.

To remove the compression belt, release the tension by pushing in on the compression knob. Release the compression belt from the back assembly, and turn the compression knob to wind it back to the rachet assembly.

It is recommended that both compression belts be removed from the table when they are not in use.

UROLOGICAL KNEE CRUTCHES (FIGURE 2-11) - Both knee crutches can be independently positioned.

The appropriate knee crutch must be installed on the correct side of the table.

To attach the urological knee crutches:

1. Open the clamp as far as it will go by turning the knurled clamping knob counterclockwise while holding the base.

2. Slide each knee crutch clamp onto the edge of the table top with the clamping knob toward the foot end.

3. Position it at the desired location and tighten it by turning the clamping knob clockwise.

4. Repeat the above steps to install the remaining knee crutch.

Knee crutch adjustment is accomplished by the use of both the clamping and adjustment knobs. Loosening the clamping knob allows the entire knee crutch assembly to slide along the length of the table top. Loosening the adjustment knob allows the crutch to slide and rotate on its support shaft. The knee crutch adjustment consists of sliding and rotating each to the desired position and re-tightening the clamping and adjusting knobs.

To remove the knee crutches, complete the above procedure in reverse.

It is recommended that the knee crutches be removed from the table top when they are not in use.

2.7 SYSTEM ACCESSORIES (continued)

HEAD HOLDER (FIGURE 2-12) - attaches to the table top by means of two (2) lever actuated vacuum suction cups. To attach and use the head holder:

1. Position the head holder at the desired location with the actuating levers together.

2. Activate the vacuum cups by spreading the actuating levers apart.

3. Open the clamp by turning the adjusting knob counterclockwise.

4. Position the patient's head in the clamp and tighten the adjusting knob, as necessary.

WARNING

FOR PATIENT SAFETY AND COMFORT, ASSURE HEAD HOLDER IS NOT APPLIED TOO TIGHTLY.

LATERAL CASSETTE HOLDER (FIGURE 2-13) - This accessory does not attach to the table. The patient's weight on the base holds it in place. It can accommodate any cassette size up to 14" X 17" (35 cm X 42 cm).

PATIENT FOOTSTEP (FIGURE 2-14) - The retractable patient footstep is located at the head end of the table. Simply grasp it and pull it all the way out.

NOTE

The table cannot be tilted with the footstep pulled out.

2.7 SYSTEM ACCESSORIES (continued)

MOBILE GRID/CASSETTE HOLDER (FIGURE 2-15) - accommodates film cassettes up to 17 inches in size by inserting them in a slot formed by two (2) vertically adjustable parallel bars. These parallel bars are locked in the desired vertical position by a knob located on the right side of the top parallel bar. An additional slot in front of the film cassette slot is provided for the placement of a stationary grid.

The mobile stand can be moved to the desired position by standing behind the stand and placing a foot against its base. Then, grasp the top of the stand, tilt it backwards onto its wheels, and move it to the desired position.

The grid/cassette holder is counterbalanced and can be moved vertically to the desired position by loosening the knob on the back of the lower parallel bar, sliding the grid/cassette holder vertically, and locking it in place by tightening the knob.

Two (2) screwdriver adjustments are provided on the base to raise the back, taking the weight off of the wheels. Turning the screws clockwise raises the base. Turning them counterclockwise lowers the base.

MCT-II SIZE-SENSING TRAY (FIGURE 2-16) - This tray is used in conjunction with the collimator to focus the x-ray beam on the cassette and to minimize stray radiation.

The size-sensing tray is located in the grid chamber tray immediately under the table top.

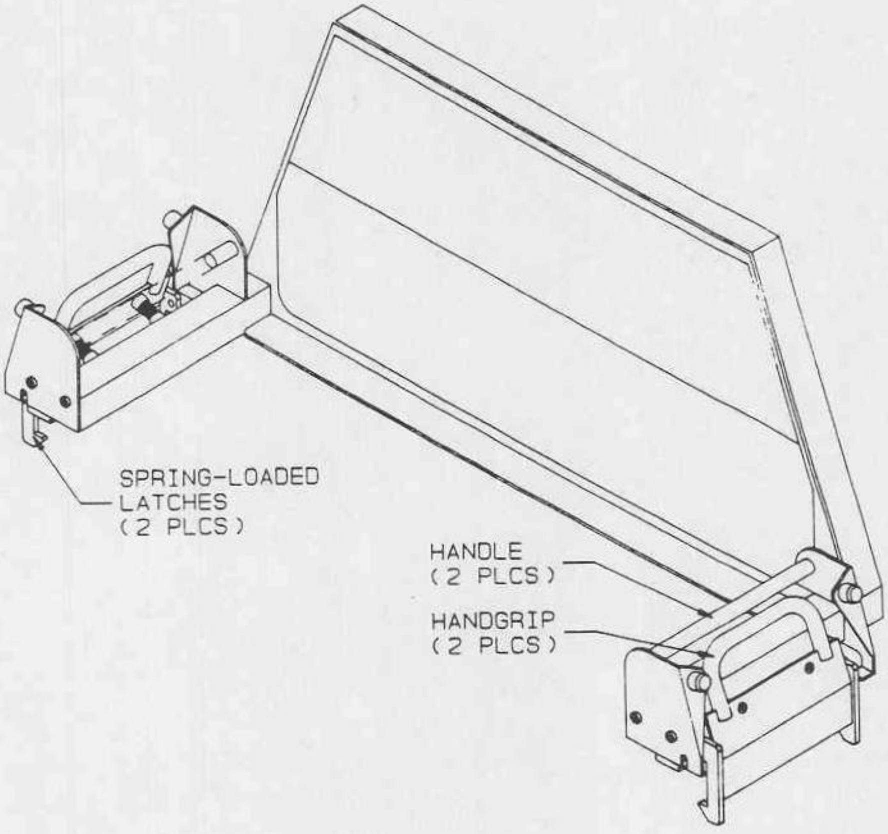

SPRING-LOADED
LATCHES
(2 PLCS)
HANDLE
(2 PLCS)
HANDGRIP
(2 PLCS)

FIGURE 2-7 FOOT REST

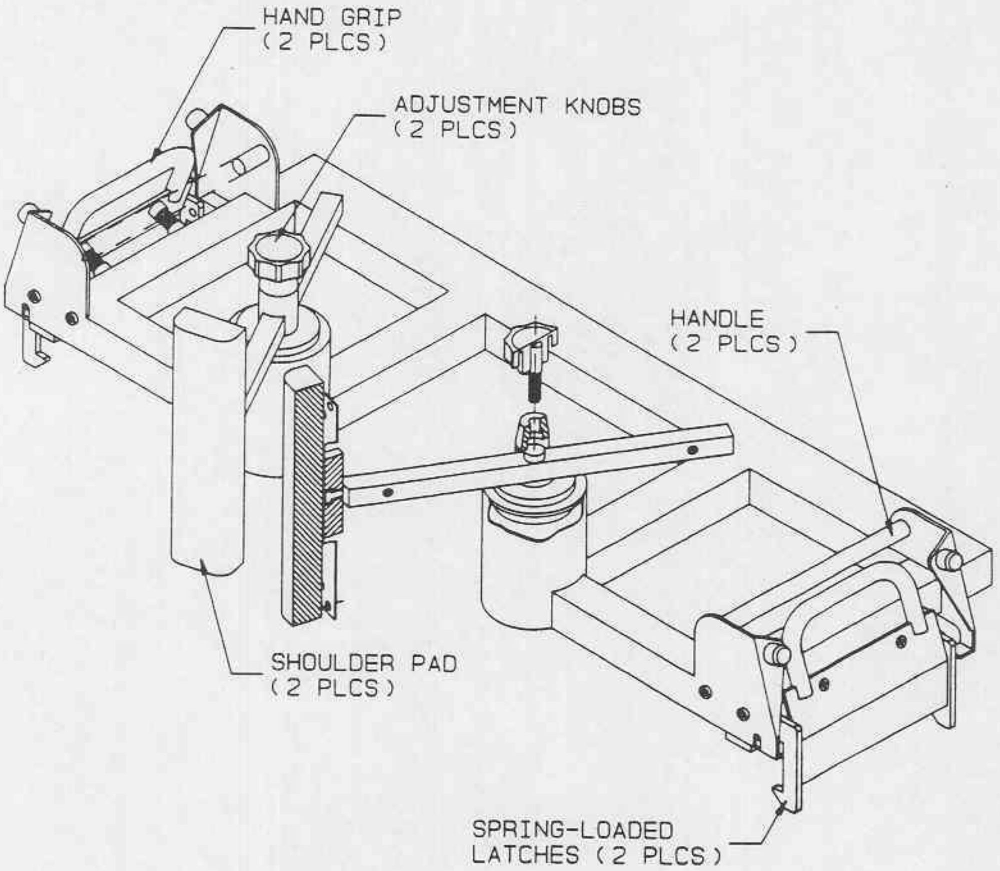

HAND GRIP
(2 PLCS)
ADJUSTMENT KNOBS
(2 PLCS)
HANDLE
(2 PLCS)
SHOULDER PAD
(2 PLCS)
SPRING-LOADED
LATCHES (2 PLCS)

FIGURE 2-8 SHOULDER REST

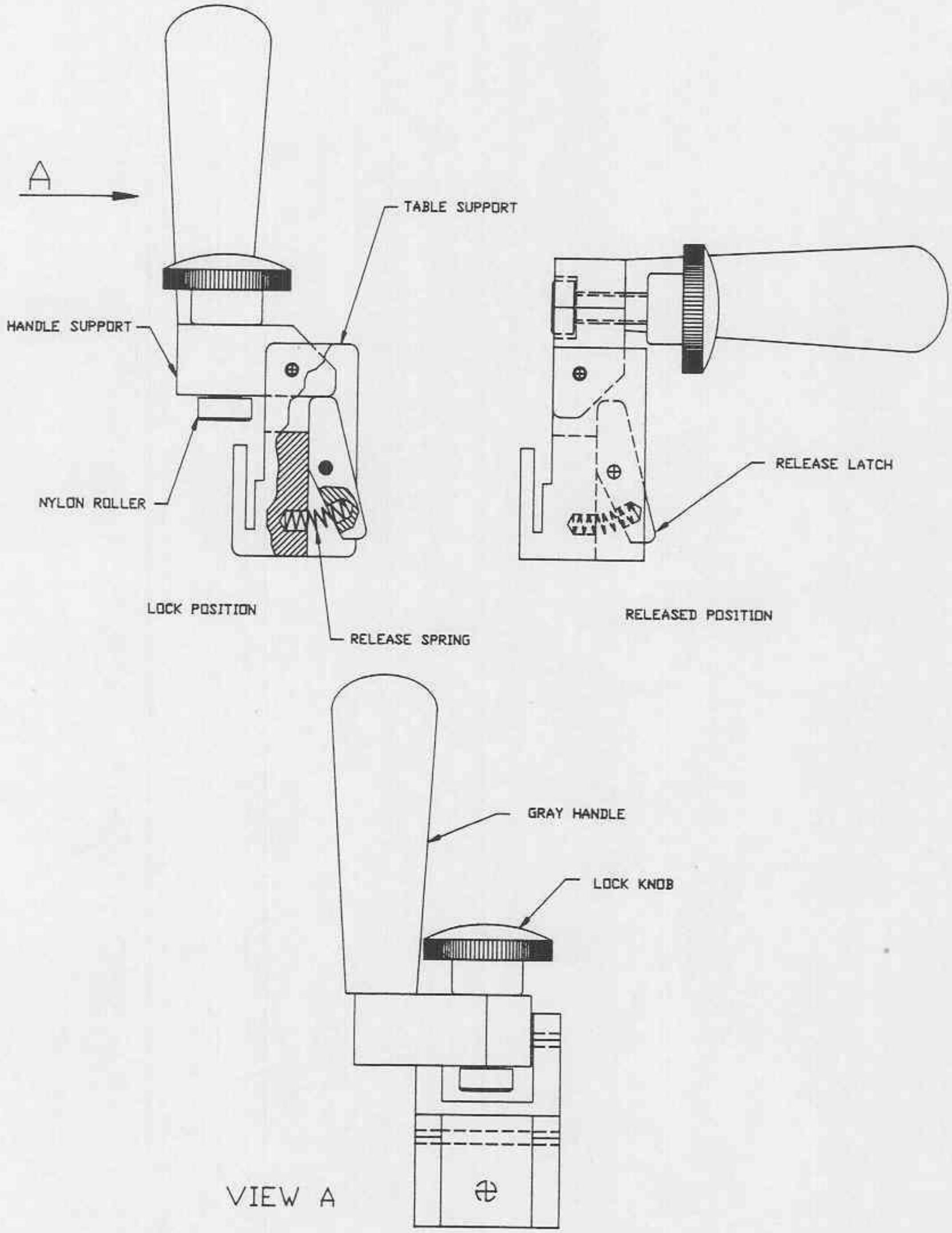

A
TABLE SUPPORT
HANDLE SUPPORT
NYLON ROLLER
RELEASE LATCH
LOCK POSITION
RELEASED POSITION
RELEASE SPRING
GRAY HANDLE
LOCK KNOB
VIEW A

FIGURE 2-9 PATIENT HAND GRIPS

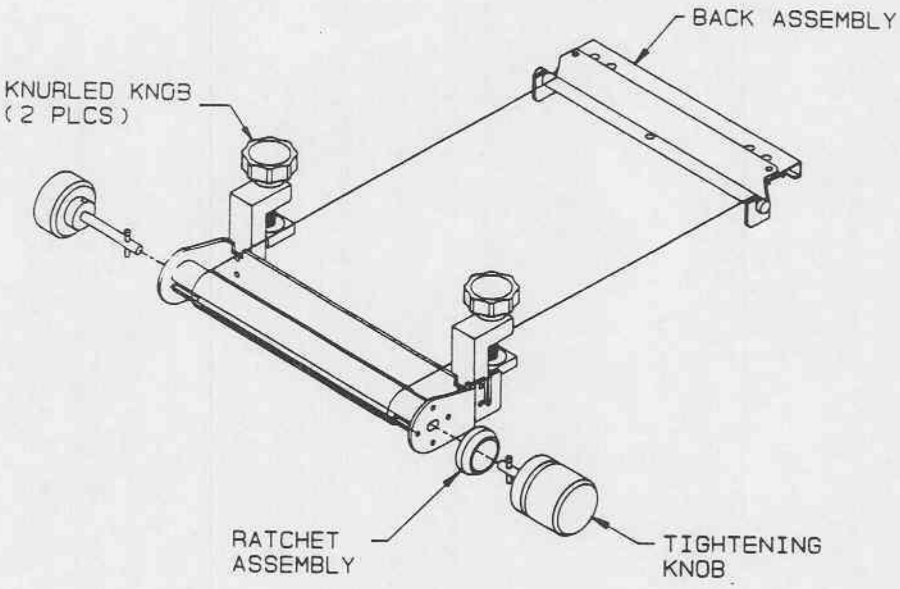

BACK ASSEMBLY
KNURLED KNOB
(2 PLCS)
RATCHET
ASSEMBLY
TIGHTENING
KNOB

FIGURE 2-10 COMPRESSION BAND

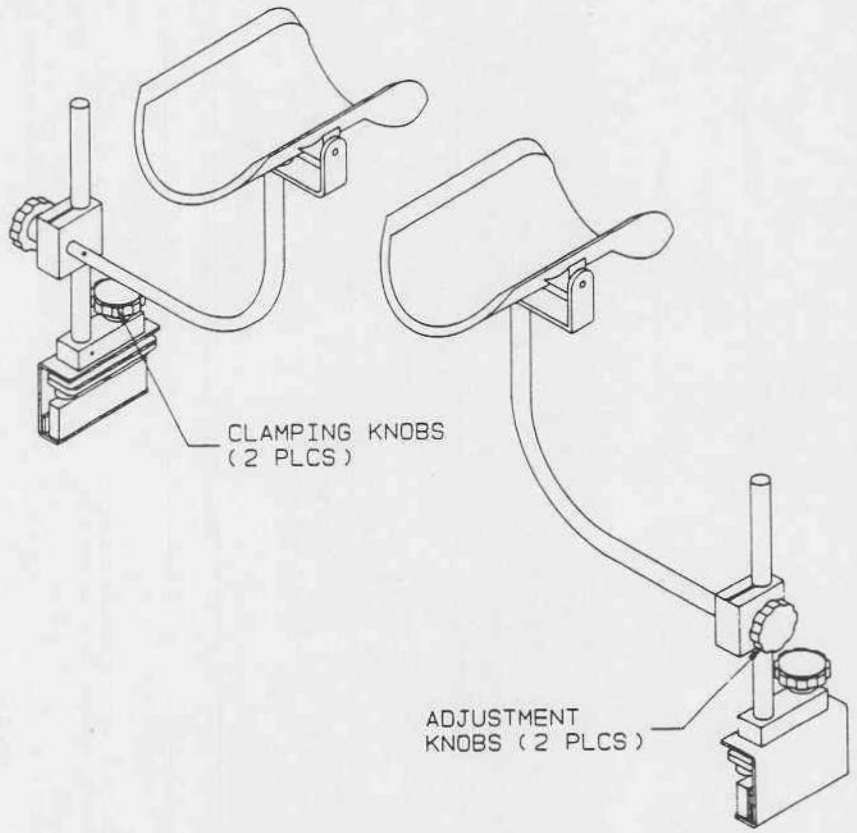

CLAMPING KNOBS
(2 PLCS)
ADJUSTMENT
KNOBS (2 PLCS)

FIGURE 2-11 UROLOGICAL KNEE CRUTCHES

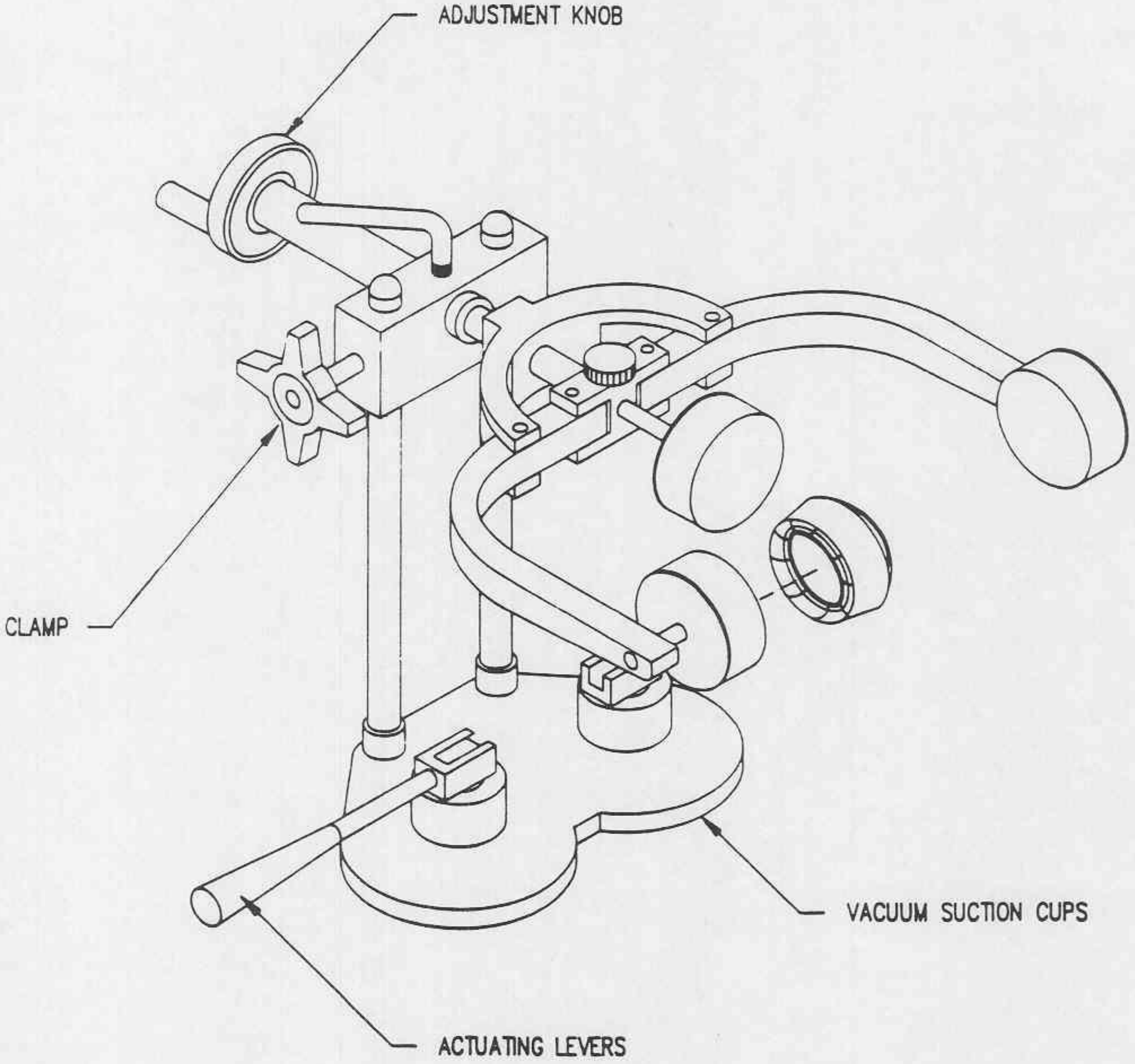

ADJUSTMENT KNOB
CLAMP
VACUUM SUCTION CUPS
ACTUATING LEVERS

FIGURE 2-12 HEAD HOLDER

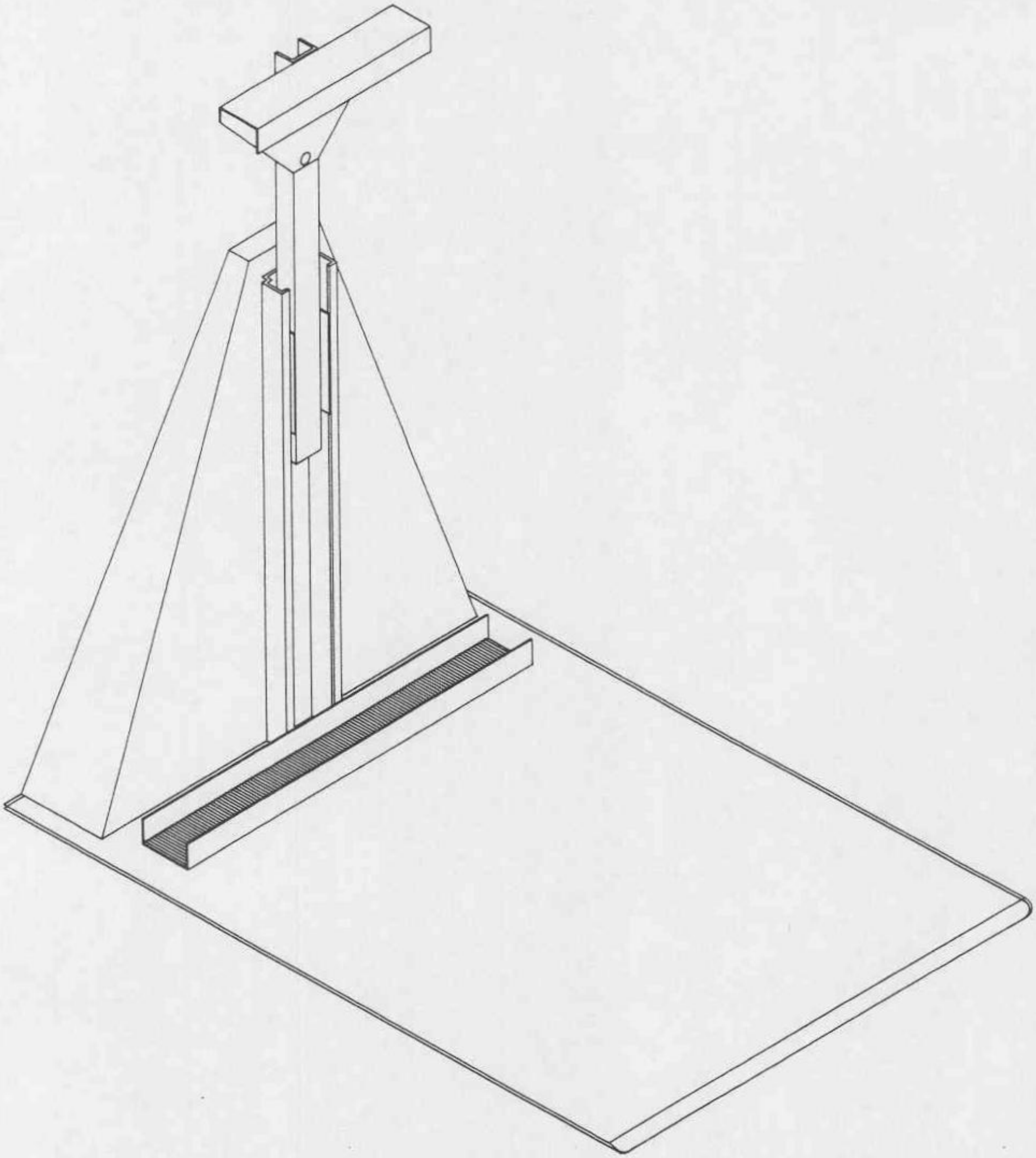


FIGURE 2-13 LATERAL CASSETTE HOLDER

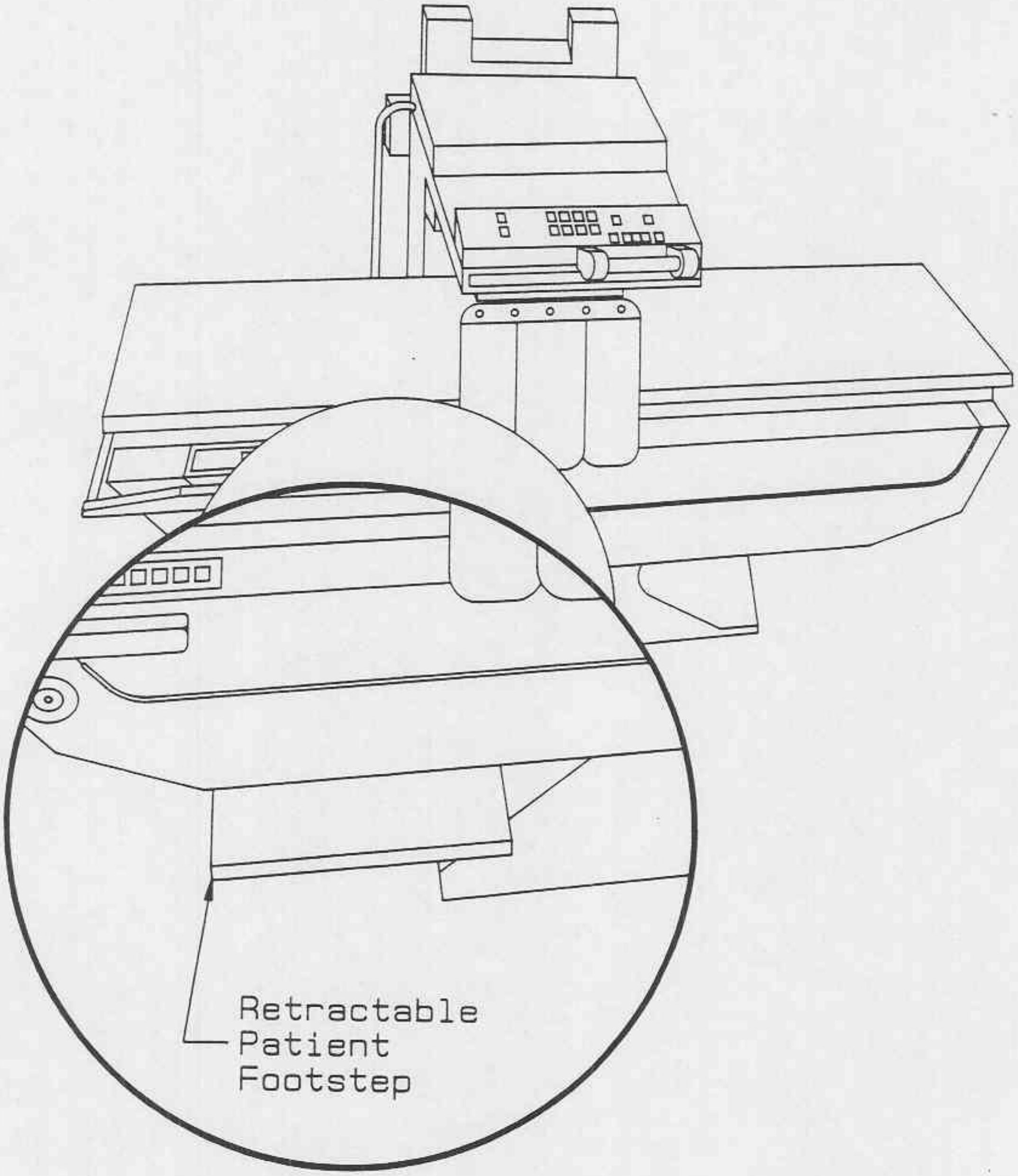

Retractable
Patient
Footstep

FIGURE 2-14 PATIENT FOOTSTEP

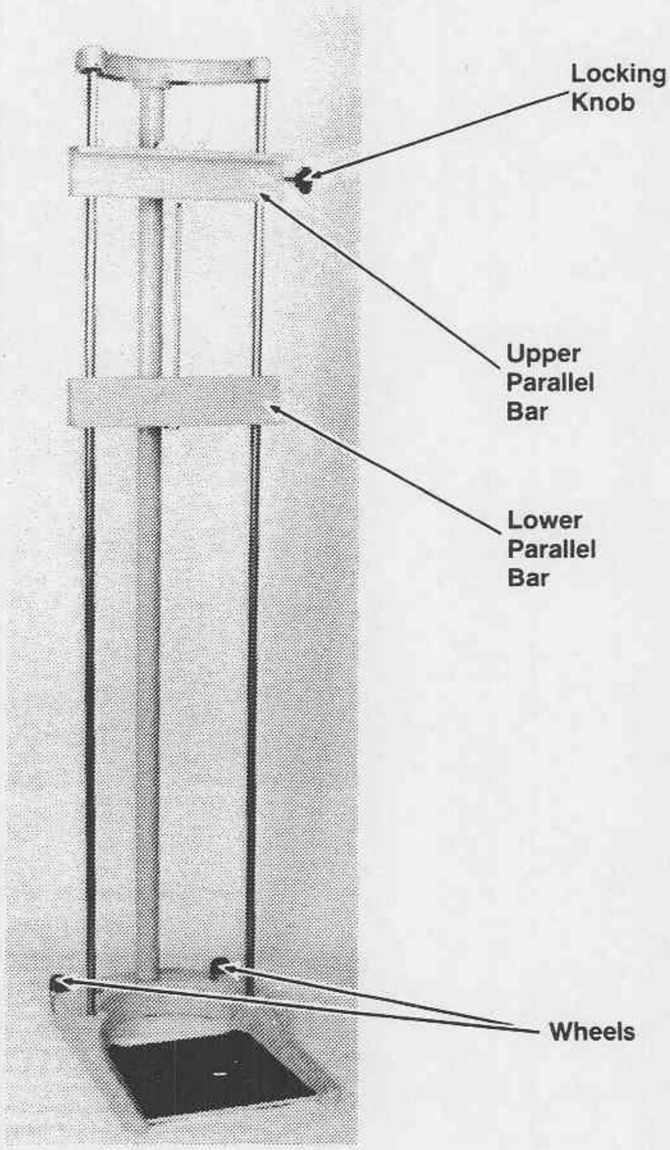

Locking Knob
Upper Parallel Bar
Lower Parallel Bar
Wheels

FIGURE 2-15 MOBILE GRID/CASSETTE/HOLDER

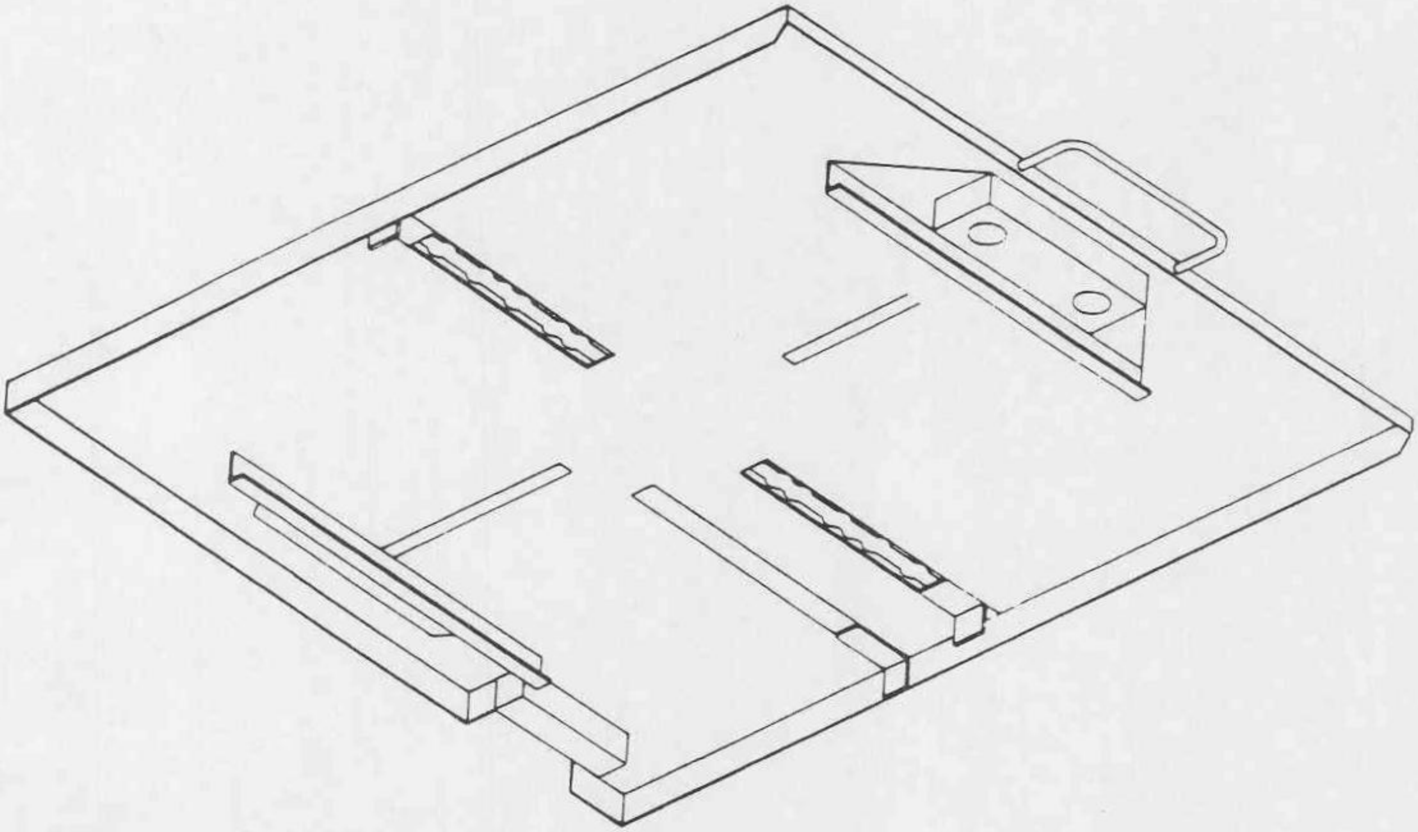


FIGURE 2-16 CASSETTE SENSING TRAY

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SECTION 3 - DAILY PRE-OPERATIONAL SYSTEM CHECK

3.1 INTRODUCTION

This section consists of a system check procedure that should be performed before examining the first patient of the day. Refer to FIGURES 2-1, 2-2, 2-4, and 2-5, as needed. The operational tests in this section are needed to ensure patient safety and proper system operation.

3.2 DAILY PRE-OPERATIONAL SYSTEM CHECK

Apply power to the system by pressing the MAINS push button on the generator front panel. Observe the line set meter. **The pointer should be positioned directly over the center reference mark.**

If it is not, use the fine and coarse line adjust controls to center it.

3.2.1 TABLE CHECK

When performing these tests, pay particular attention to smoothness and ease of operation. Make sure that there is no squeaking, or other unusual noises, or malfunction(s). Exercise all table motions as follows, beginning with the table top centered in the horizontal position (see FIGURE 2-4 for switch locations):

- Press and hold the longitudinal head switch (A) until the table top reaches its limit of travel. It should move approximately 30" from its centered position before it stops.

- Press and hold the longitudinal foot switch (B) until the table top reaches its limit of travel. It should move approximately 30" from its centered position before it stops.

- Press and hold the table center switch (C) until the table top stops. It should move to its center position, from either of the above mentioned longitudinal positions, before stopping.

- Press and hold the Trendelenburg tilt switch (D) until the table reaches its maximum tilt of 12° toward Trendelenburg and stops.

- Press and hold the vertical tilt switch (E). The table should stop at the horizontal position. Release the switch, and press and hold the switch again. The table should rotate to its maximum tilt of 88°, providing the table top is on "center" (in free standing or tactical shelter setup).

The spot film device must be at or near the foot end of the table if in the tactical shelter configuration.

3.2.1 TABLE CHECK (continued)

- Press and hold the Trendelenburg tilt switch until the table stops at horizontal. Release the switch.

WARNING

A FAULTY LOCK CAN CAUSE SERIOUS INJURY. DO NOT USE A SYSTEM WITH MALFUNCTIONING LOCKS.

On the spot film device, disengage the carriage (CARR) locks and the compression (COMP) locks and move the spot film device in all directions. It should take a minimum of twenty pounds force to move the spot film device in any direction.

3.2.2 TUBESTAND CHECK

Verify that the tubestand is energized by operating the locks and moving it through its various motions. Check the collimator to ensure that all lamps will light.

3.2.3 SPOT FILM DEVICE CHECK

Observe the spot film device for the presence of power. All push buttons should be lit. Cycle the cassette carriage by pressing the PARK/LOAD switch. The carriage should alternate between its park and load positions.

3.2.4 WARM-UP PROCEDURE

WARNING

IT IS NECESSARY TO MAKE EXPOSURES IN THE STEPS THAT FOLLOW. TAKE ALL PRECAUTIONS NECESSARY TO PROTECT PERSONNEL AGAINST UNNECESSARY RADIATION.

3.2 DAILY PRE-OPERATIONAL SYSTEM CHECK (continued)

3.2.4 WARM-UP PROCEDURE (continued)

Disable autotiming, and close the collimator blades. Select 70 kVp, 100L mA, 1.0 second.

Warm up the over-table x-ray tube by making four (4) exposures at 15 second intervals.

NOTE

Always perform the above "warm-up" procedure no more than one (1) hour before the first case of the day, or if the system has been idle for one (1) hour or longer.

Make a fluoroscopic exposure by performing the following steps:

1. Press the 200L SPOT push button switch on the generator front panel.

2. On the fluoroscopic controls section of the generator panel, select mA station B and rotate the minutes to the 5 (minute) position.

3. Rotate the fluoroscopic kVp control until 70 kV is indicated on the fluoroscopic kVp meter. Ensure that the spot film device cassette carriage is in the park position.

4. Place a suitable fluoroscopic phantom on the table top in the in-beam position.

5. Depress either the footswitch or x-ray push button on the spot film device.

6. Observe the imaging system mirror. A sharp, clear x-ray image of the grid chamber mechanism should be displayed.

TURN OFF THE SYSTEM BY PRESSING THE MAIN BREAKER SWITCH.

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SECTION 4 - OPERATING PROCEDURES

4.1 INTRODUCTION

This section identifies the procedures required for a radiographic, spot film and fluoroscopic exposure.

4.2 POWER APPLICATION

All components obtain power by activating the MAINS push button (switch C in FIGURE 2-1). The procedures discussed in this section require the operator to turn power on by using the MAINS switch. According to departmental protocol, turning power off will be accomplished at the completion of the x-ray procedure or end of shift as appropriate.

Check the line set voltage meter (AN in FIGURE 2-1) on the generator main control panel to assure proper power requirements. If adjustments are required, use the coarse line adjust (AH in FIGURE 2-1) or fine line adjust (AI in FIGURE 2-1) switch to correct them.

4.3 RADIOGRAPHIC PROCEDURES

Turn power on. Perform warm-up procedure described in paragraph 3.2.4.

4.3.1 RADIOGRAPHY WITHOUT AUTOTIMING

1. Select the desired radiographic mA control.

2. Measure the patient (affected body part) with calipers to determine appropriate kVp selection.

3. Set the desired radiographic kVp, using the major kVp and minor kVp knobs, in conjunction with the kVp meter on the main control panel.

4. Select the desired radiographic time, radiographic seconds.

5. Select "Autotiming" off at the main control panel.

6. Position patient on table.

7. Select appropriate size cassette and place it under the patient (affected body part).

4.3.1 RADIOGRAPHY WITHOUT AUTOTIMING (continued)

8. Measure source-to-image distance. Adjust collimator light field to equal the size of the cassette.

9. **Press the PREPARE and EXPOSE push button simultaneously to execute x-ray exposure.**

10. Remove cassette and develop film.

4.3.2 RADIOGRAPHY WITH AUTOTIMING

Proceed in the same way as for "Radiography without Autotiming", with these additions:

- Set "Autotiming" on.

- Set radiographic seconds on the timer for at least 50% longer than the anticipated exposure.

- The ion chamber in the table has three (3) fields. The operator must select the appropriate fields, depending on the body part to be radiographed. Press TABLE on the Autotimer section. This activates the ion chamber in the table.

- Select the appropriate density.

4.4 FLUOROSCOPIC PROCEDURE

1. Turn power on.

2. Select the 200L SPOT mA station (H in FIGURE 2-1) on the main control panel. Depressing the 200L SPOT push button selects the 200 mA station on the large focal spot of the under-table x-ray tube for spot film techniques. This switch also disables the PREPARE and EXPOSE switches (P and Q in FIGURE 2-1) so that their functions can be activated from the spot film device control panel or the table footswitch.

3. Select the desired fluoro kVp (AE in FIGURE 2-1) on the main control panel.

4. Select the desired fluoro mA (A in FIGURE 2-1) on the main control panel.

4.4 FLUOROSCOPIC PROCEDURE (continued)

5. Select the desired fluoro time (B in FIGURE 2-1) on the main control panel.

This control allows the operator to make fluoroscopic exposures of up to five (5) minutes in duration. After five minutes, this control must be manually reset.

6. Position patient on table.

7. Move the spot film device over the patient.

8. Press the PARK/LOAD push button (G8 in Figure 2-2) to ensure spot film cassette is now in its operating park position.

10. For fluoroscopy, press the footswitch or X-RAY push button (E in figure 2-2) on the spot film device control panel. The fluoro timer is activated only while fluoroscopy is in process.

11. Adjust the mirror assembly on the image intensifier to optimize viewing.

4.5 FLUOROSCOPY WITH SPOT FILM PROCEDURE

1. Turn power on.

2. Select the 200L SPOT mA pushbutton (H in FIGURE 2-1) for all spot film and fluoroscopy work.

3. Select an appropriate radiographic kVp using the major kVp and minor kVp Knobs (AF and AG in FIGURE 2-1).

4. Set the radiographic seconds to the desired exposure time. If autotiming is to be used, select radiographic seconds for a time at least 50% greater than the expected exposure time. This serves as a back-up exposure termination in the event of autotimer failure.

5. Set the fluoroscopic kVp to the desired level using the fluoroscopic kVp knob (AE in Figure 2-1).

6. Set the desired fluoroscopic mA on the fluoroscopic control section of the control panel (FIGURE 2-1). Selections A, B, and C are for low-level mA settings. Selections D and E are for high-level mA settings.

A, B, and C levels are obtained whenever either the X-RAY button on the spot film device or the footswitch is pressed. Levels D and E are obtained only when selected and when the footswitch is pressed hard enough to activate its second stage.

When D or E is selected, level C is obtained from the spot film device on the first stage of the footswitch. When high level is activated, a repetitive beep will be heard from the x-ray control until high level is released.

7. Set the fluoro timer (B in FIGURE 2-1) to 5 minutes. The fluoro timer keeps track of the accumulated fluoroscopic exposure time. At the end of 5 minutes, fluoro exposure is terminated, and no further fluoro exposure is allowed until the timer is reset.

8. If autotiming of spot films is desired, depress the AUTOTIMER ON/OFF button selecting autotimer on.

Select the spot film detector and any field. The spot film detector has only one field so which field is selected does not affect operation.

Density selection is made from the density switch on the spot film device control panel (C in FIGURE 2-2).

4.5 FLUOROSCOPY WITH SPOT FILM PROCEDURE (continued)

NOTE

If the AUTOTIMER RESET button illuminates at the end of a spot film exposure, it means that the selected radiographic time was too short, and the timer rather than the autotimer terminated the exposure. Increase either time or kVp to prevent recurrence.

9. Position patient on table.

10. Press CARR locks switch (A in FIGURE 2-2) on the spot film device to disengage the locks, if necessary, and move the spot film device into the locked in-beam position.

11. Load a cassette through the front panel slot.

12. Re-engage the locks by pressing CARR locks a second time.

13. Position the compression cone at spot film device, if desired.

14. Select the desired mode of the SHTR AUTO push button on the spot film sevice.

15. Press and hold the PREPARE push button on the spot film device.

16. Press the X-RAY push button or the footswitch.

The PREPARE push button and one of the X-RAY switches or the footswitch must be simultaneously pressed and held once for each exposure.

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SECTION 5 - BIOLOGICAL EFFECTS OF RADIATION

5.1 GENERAL

The effects of x-radiation on living tissue are generally assumed to be almost entirely the result of ionization. The disruption of tissue molecules by recoiling particles, especially neutrons, is also a factor. The effect of continual exposure to small amounts of radiation can be very subtle, producing no apparent change in the health of the individual. However, genetic changes may occur causing mutations in later generations.

Just how much x-radiation can cause this kind of damage is the subject of disagreements between geneticists and physicians. It may be safely assumed that if the present Atomic Energy Commission (AEC) requirements are met, no appreciable genetic change will be observed. One of the covert effects is the destruction of blood producing tissue in bone marrow, causing symptoms of anemia and other blood cell damage.

The following shows the effects of acute radiation doses within a 24-hour period over the whole body:

O - 5 R	No obvious injury.
5 R -25 R	First detectable blood change.
25 - 50 R	Blood changes - No serious injury.
50 - 100 R	Blood changes, some injury, no disability.
100 - 200 R	Injury, possible disability.
200 - 400 R	Injury and disability certain, possible death.
400 - 500 R	Fatal to 50%.
600 R or more	100% fatalities.

5.1 GENERAL (continued)

TIME AFTER EXPOSURE	MODERATE DOSE (100 - 300 R)	MEDIUM LETHAL DOSE (400 R)	LETHAL DOSE (600 R)
First Week	No definite symptoms	Nausea and vomiting after 1 - 2 hours. No definite symptoms	Nausea and vomiting after 1 - 2 hours. No definite symptoms. Diarrhea. Throat and mouth inflammation
Second Week			Fever, rapid loss of weight. Mortality 100%
Third Week		Beginning of loss of hair by the roots. Loss of appetite and uneasiness. Fever, throat and mouth inflammation.	
Fourth Week	Moderate weight loss. Recovery likely unless complications exist.	Diarrhea, nosebleeds, pale skin, weight loss rapid. 50% mortality rate.	

TABLE 5-1 RESULTS OF WHOLE BODY EXPOSURE TO X-RADIATION

5.1 GENERAL (continued)

DOSE RATE	PERIOD OF TIME AT DOSE RATE	EFFECT
500 R/Day	2 Days	Mortality close to 100%.
100 R/Day	Until death occurs	Mean survival time about 15 days. 100% mortality in 30 days.
60 R/Day	10 Days	Morbidity and mortality rate high with crippling injuries.
30 R/Day	10 Days	Disability moderate.
10 R/Day	365 Days	Some deaths.
3 R/Day	Few Months	No drop in efficiency.
0.5 R/Day	Many Months	No large scale drop in life span.

TABLE 5-2 ESTIMATED DOSES FOR VARYING DEGREES OF INJURY

Comparison of TABLES 5-1 and 5-2 indicates that it makes a difference how the dose is received. It is less harmful to receive numerous smaller dosages rather than a single large exposure of the same total.

BLOOD TESTS - A great deal of reliance had been placed on blood tests in the early days when other means of determining exposure rates were unreliable, unavailable, or unknown.

Roentgenologists may be able to determine that radiation damage has occurred in the blood with an exposure of 1 R, providing that a complete medical history of the patient is available. This includes blood test reports taken at least monthly over an extended period of time. Lacking this previous history, it is doubtful if the Roentgenologist can be certain damage has occurred with exposures less than 5 R.

Natural and Diagnostic Exposures

Cosmic Rays, Average	0.1 R/Year
Cosmic Rays, Denver, Colorado	0.5 R/Year
Routine Chest X-ray*	.01 to 0.5 R/Exposure
Routine Gastro-Intestinal X-ray*	1 R/Exposure
Fluoroscopic Examination*	2 to 10 R/Minute
Cinefluorography (X-ray Movie)*	25 R/Examination

* These exposures are to parts of the body only.

5.1 GENERAL (continued)

THE MAXIMUM PERMISSIBLE DOSE

About thirty days after Roentgen's announcement of his discovery of x-rays, in December 1895, Emil Grubb of Chicago reported radiation injury to himself in the form of dermatitis on his hands. The first attempts to establish Maximum Permissible Dose limits were based on the dose required to produce skin erythema.

In the last twenty years, emphasis has shifted to the genetic effects which are not thought to be subject to the repair process, and as a result, there can be no tolerance dose. The accumulative population dose from all radiation sources, including background, is the prime consideration rather than the individual dose, and a small number of radiation workers may be subjected to higher levels of radiation as long as the hazard of genetic effects to the total population are not considered to be increased.

In 1958, the International Committee on Radiation Protection (ICRP) recommended a maximum accumulation whole body dose for occupational personnel of 5 (N-18) rems where N is the body age of the individual. This amounts to an average dose of 5 rems per year past the age of eighteen (18). It was further specified that no more than 3 rems should be accumulated in any 13 week period. Medical exposures are excluded.

It was also recommended that non-occupational people or persons outside a controlled area should receive no more than 0.5 rem per year from external radiations. Federal regulations (Title 10, Section 20) are more restrictive, requiring a Maximum Permissible Dose of 1-1/4 rems per calendar year quarter for most radiation work. The U.S. Atomic Energy Commission is currently permitting the various states to set up their own regulatory agencies providing certain minimum requirements are met.

On the subject of Maximum Permissible Dose, a motto worthy of consideration is:

"Think of minimum possible exposure rather than maximum permissible dose".

Shielding of a radiographic room is specified in appropriate publications (NCRP REPORT #34) and is determined with the aid of a qualified expert.

SECTION 6 - RADIOGRAPHIC TECHNIQUES FOR THE AVERAGE LABORATORY

6.1 INTRODUCTION

The instructions in this section can be used as a guideline. They will provide a starting point if it is necessary to devise an appropriate technique or investigate a radiographic problem.

This technique is based on the variable voltage or thickness of body part, where kVp is adjusted depending on the thickness of the body part and the mAs remains constant. It provides a means of converting the tabulated data to various film/screen speeds other than high speed calcium tungstate. It enables operators to develop a technique for a given body part when the factors for another part are known.

Before proceeding, make sure the x-ray timer is accurate, the generator is properly calibrated, and the kVp and mA are correct on both x-ray tubes and on all mA stations. An aluminum ladder film should be made using the same kVp and mAs on each tube and mA selection and the density of each corresponding step should be the same. Make sure all accessories are operating correctly and darkroom solutions are fresh. All techniques discussed apply to single phase x-ray generators.

6.2 BASIC TECHNIQUES - The accompanying Technique Chart (TABLE 6-1) provides a beginning point for developing a technique chart for a particular x-ray system under specific circumstances. It is not possible to anticipate all variations due to line drop under load, x-ray tube condition, etc. These will have to be accounted for by making a Technique Chart under actual operating conditions. The supplied chart will, however, provide a reasonable approximation of the required factors.

6.3 USING THE CHART - The Technique Chart is organized by study type (body part). Locate the desired heading for the study to be performed. If the specific study is not listed, use the study that covers the same anatomical area and tissue type. For example, if the desired study is the kidneys, use ABDOMEN. Measure the patient and locate the thickness in the CM row. Find the correct position and read the desired kVp directly below the patient's thickness. Set the mA station and time as specified for that position.

MXR-350 X-RAY TECHNIQUE CHART

CERVICAL SPINE

Position: ALL Distance: 40" Grid: Yes mA: 100S Time: 1/5 mAs: 20

CM	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
kVp	52	55	58	61	64	67	70	72	75	78	81	83	85	88	90

THORACIC SPINE

Position: AP, OBL Distance: 40" Grid: Yes mA: 300L Time: 1/4 mAs: 75

CM	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
kVp	54	56	59	61	63	65	68	72	75	77	80	82	85	87	90	93	96	100	104	107	110
Position: LAT Distance: 40" Grid: Yes mA: 300L Time: 1/4 mAs: 75																					
kVp			54	56	58	60	62	65	67	69	71	73	74	76	78	80	82	84	86	88	90

LUMBAR SPINE

Position: AP, OBL Distance: 40" Grid: Yes mA: 200L Time: 1 mAs: 200

CM	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
kVp	55	58	61	64	67	69	72	76	80	83	86	89	93	97	100	103	105	108	111	115	118
Position: LAT Distance: 40" Grid: Yes mA: 200L Time: 1 mAs: 200																					
kVp	63	65	68	71	72	74	76	78	80	81	83	85	87	88	90	93	97	100	102	105	108

HIPS & PELVIS

Position: AP, OBL, Frog Leg Distance: 40" Grid: Yes mA: 200L Time: 1/4 mAs: 50

CM	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
kVp	62	65	69	73	76	80	83	86													
Position: AP, OBL, Frog Leg Distance: 40" Grid: Yes mA: 200L Time: 1 mAs: 200																					
kVp									63	66	69	72	75	79	82	85	88	91	94	97	100
Position: LAT Distance: 40 " Grid: Yes mA: 200L Time: 1/2 mAs: 100																					
kVp				59	60	62	64	66	68	70	72	74	75	77	78	80	82	83	85	86	88

EXTREMITIES

Position: ALL Distance: 40" Grid: No mA: 100S Time: 1/10 mAs: 10

CM	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
kVp		38	40	43	45	47	49	51	53	56	58	60									
Position: ALL Distance: 40" Grid: No mA: 100S Time: 1/5 mAs: 20																					
kVp													49	51	53	55	57	59	60	62	64
Position : ALL Distance: 40" Grid: Yes mA: 100S Time: 1/2 mAs: 50																					
kVp					41	43	45	47	49	51	53	55	57	59	61	63	65	68	70	72	74

NOTES:

1. For patients under the age of 12 or over the age of 60, deduct 2 cm from measured thickness.
2. For highly muscular patients, add 2 cm to measured thickness.
3. This chart is based on Standard High Speed calcium tungstate intensifying screens. For other speed systems, adjust techniques as follows:

	mAs Adjustment	OR	kVp Adjustment
Par Speed -	Multiply mAs by 1.5	OR	Multiply kVp by 1.06
High Plus -	Multiply mAs by 0.8	OR	Multiply kVp by 0.96
Rare Earth 200 -	Multiply mAs by 0.5	OR	Multiply kVp by 0.83
Rare Earth 400 -	Multiply mAs by 0.25	OR	Multiply kVp by 0.71
Rare Earth 800 -	Multiply mAs by 0.125	OR	Multiply kVp by 0.58

SKULL

Position: PA, Stenvers, Rhese Distance: 40" Grid: Yes mA: 100S Time: 1/4 mAs: 25

CM	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
kVp	45	47	49	51	53	56	60	64	69	74	78	82	85	89	93	98					
Position: PA, Stenvers, Rhese Distance: 40" Grid: Yes mA: 100S Time: 1/2 mAs: 50																					
kVp														75	78	82	85	89	93	98	102
Position: LAT, Sinus, Hickey Distance: 40" Grid: Yes mA: 100S Time: 1/4 mAs: 25																					
kVp	45	47	49	51	53	56	60	64	67	71	74	78	81	83	86	88	91	94	96	98	100
Position: Waters, Caldwell, Law Distance: 40" Grid: Yes mA: 100S Time: 1/2 mAs: 50																					
kVp	47	49	51	53	56	59	62	65	69	72	74	76	78	81	83	85	87	89	92	94	97

TABLE 6-1 BASIC TECHNIQUES

SHOULDER

Position: AP Distance: 40" Grid: Yes mA: 200L Time: 1/6 mAs: 33																					
CM	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
kVp	46	48	50	52	54	56	58	60	62	64	67	70	72	74	76	78	81	83	85		
Position: Axial Distance: 40" Grid: Yes mA: 200L Time: 1/10 mAs: 20																					
kVp	43	45	46	47	49	51	54	57	59	61	63	65	67	70	72	74	76	78	80	82	83
Position: LAT Distance: 40" Grid: Yes mA: 200L Time: 1/5 mAs: 40																					
kVp	47	49	51	53	55	57	60	62	65	67	69	72	74	77	79	81	83	85	87	89	91

CHEST*

Position: PA Distance: 72" Grid: No* mA: 300L Time: 1/60 mAs: 5																					
CM	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
kVp	73	75	77	80	82	84	85	87	89	92	95	98	100	103	105	107	110	112	115	119	124
Position: LAT Distance: 72" Grid: No mA: 200L Time: 1/30 mAs: 6.67																					
kVp	73	75	78	80	82	84	85	87	90	93	97	99	102	105	107	109	111	114	118	122	128

ABDOMEN - (No Barium)

Position: ALL Distance: 40" Grid: Yes mA: 300L Time: 1/20 mAs: 15																					
CM	08	09	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34	36	38	40
kVp	59	62	65	69	73	77	81														
mA: 300L Time: 3/20 mAs: 40																					
kVp							61	65	70	78	85										
mA: 300L Time: 2/5 mAs: 120																					
kVp											66	74	80	85	95						
mA: 300L Time: 1 mAs: 300																					
kVp														70	76	82	87	93			
mA: 200L Time: 2-1/2 mAs: 500																					
kVp																	77	81	85	90	96

* For Grid, add 3 cm to actual chest measurement.

ABDOMEN - BARIUM

Position: ALL Distance: 40" Grid: Yes mA: 200L Time: 1/60 mAs: 3.3																					
CM	08	09	10	11	12	13	14	15	16	18	20	22	24	26	28	30	32	34	36	38	40
kVp	89	93	98	103	107	112	119	126	134												
Position: ALL Distance: 40" Grid: Yes mA: 200L Time: 1/20 mAs: 10																					
kVp								98	105	115	127	139									
Position: ALL Distance: 40" Grid: Yes mA: 200L Time: 1/5 mAs: 40																					
kVp											87	96	104	110	122	135					
Position: ALL Distance: 40" Grid: Yes mA: 200L Time: 1 mAs: 200																					
kVp															82	89	97	102	108	113	122

Note: For spot films, deduct 2 cm from measured thickness of ABDOMEN - BARIUM Technique.
Autotiming (AEC) is strongly recommended for spot film work.

TABLE 6-1 BASIC TECHNIQUES (continued)

6.4 SUPPLEMENTAL INFORMATION

The technique for general radiography is not uniform from one x-ray department to another or even from machine to machine. As a result, any technique may have to be modified. It is necessary to know the efficiency of the equipment as well as the condition and types of screens, film, and processing solutions. Determine the techniques that produce satisfactory films for the body parts listed in TABLE 6-1 and calculate the other techniques.

Very young or old people may require 4 to 8 kVp less than normal, except for a small child's chest.

6.4 SUPPLEMENTAL INFORMATION (continued)

Muscular individuals may require 4 to 5 kVp more than average, while emaciated persons require 4 to 5 kVp less.

If pathology is present, the tissue may be more or less opaque than average. Some knowledge of existing pathology may be necessary in order to make the needed allowances.

Refer to TABLES 6-2 and 6-3 for various conversion factors and basic rules of use.

GRID CONVERSION FACTORS	
KVP CONSTANT	
GRID RATIO	**MAS**
5:1	2 X Non-Grid mAs
6:1	3 X Non-Grid mAs
8:1	4 X Non-Grid mAs
10:1	5 X Non-Grid mAs
12:1	5 X Non-Grid mAs
16:1	6 X Non-Grid mAs
MAS CONSTANT	
GRID RATIO	**INCREASE NON-GRID KVP**
5:1	Add 10 - 12 kVp
6:1	Add 10 - 15 kVp
8:1	Add 12 - 18 kVp
12:1	Add 15 - 21 kVp
16:1	Add 18 - 24 kVp

TABLE 6-2 GRID CONVERSION FACTORS

6.4 SUPPLEMENTAL INFORMATION (continued)

USEFUL KVP RANGE - It is desirable to keep the kVp between certain limits in order to image various parts of the body.

REGION	KVP RANGE
Mastoids & Jaw	55 - 75
Skull	55 - 90
Sinuses	55 - 75
Pelvis & Spine	55 - 90
Chest	60 - 130
Abdomen	55 - 90
Extremities	40 - 80

TABLE 6-3 APPROXIMATE ANATOMICAL KVP RANGES

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SECTION 7 - OPERATOR MAINTENANCE

7.1 INTRODUCTION

Operators can make a valuable contribution to equipment maintenance by making frequent visual inspections of the equipment, associated hardware, and wiring. They can often identify potential malfunctions before they cause an equipment failure that could be dangerous to both patients and operators.

WARNING

ALWAYS CONTACT A QUALIFIED MEDICAL EQUIPMENT REPAIRER TO CORRECT PROBLEMS THAT MAY BE FOUND DURING THE COURSE OF AN INSPECTION.

CAUTION

THE X-RAY SYSTEM CONTAINS NO OPERATOR SERVICEABLE PARTS. REFER ALL SERVICING TO A QUALIFIED BIOMEDICAL MAINTENANCE TECHNICIAN.

7.2 SYSTEM INSPECTION

Test all front panels controls and the meters for correct operation and to ensure that they light properly.

Check all nuts and bolts, screws, rivets, and other fasteners to ensure that they are tight. Also be sure that all fasteners are present and in good condition.

Inspect all electrical cables, cords, connectors, and fittings for tightness. Check for breaks in the insulation, abrasions, and other damage to cables and connectors. Pay particular attention to the high voltage cables and areas where electrical cable enters cable housings for they are subject to stress from mechanical motions.

Examine all exterior painted or plated surfaces for evidence of deterioration, such as scratches, chipping and corrosion. Make sure that all name plates and warning labels are present, legible and securely mounted.

Perform the Daily Pre-Operational System Check, Section 3.

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SECTION 8 - SYSTEM CLEANING INSTRUCTIONS

WARNING

ALWAYS TURN POWER OFF BEFORE BEGINNING ANY CLEANING PROCEDURE.

8.1 GENERAL

Spillage of liquid on any component can cause a malfunction, particularly if it finds its way into the interior. This is especially so with liquids that leave a solid residue after they dry. It is important to promptly remove spills with a soft cloth dampened in warm water.

Regular cleaning of almost all components can be accomplished with a soft cloth, warm water, and a mild detergent.

8.2 IMAGE INTENSIFIER CLEANING

The output lens and the viewing mirror on the image intensifier are susceptible to dust accumulation and smudging due to handling. It is recommended that the operator have access to some type of lens tissue and lens cleaning solution to clean the mirror and outer lens.

Any material that could cause scratching or any other type of permanent marking should be avoided.

8.3 TUBESTAND

The exterior of the tubestand should be wiped down with a mild soapy solution and clean, dry cloths to rid it of dust and foreign materials. Particular attention should be paid to the steel transport rails.

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SECTION 9 - STORAGE INFORMATION

9.1 GENERAL

The system can be indefinitely stored indoors or outdoors, if it is protected from rain, at temperatures not exceeding 122° F (50° C) relative humidity no greater than 100%. If these limits are exceeded for more than 24 hours, the system must be installed and allowed to acclimate for at least 24 hours before power is applied.

9.2 STORAGE INFORMATION OF SPOT FILM DEVICE

The spot film device can be stored for as long as eight (8) years in environments whose temperature and relative humidity do not exceed 122° F (50° C) and 100%. Exceeding these limits may cause deterioration of the cassette carriage drive belts.

In addition, tension on the drive belts may distort them when they are unused for an extended period of time. It is recommended that the tension be relaxed on all belts if the spot film device is to be stored for more than six months. Do this by loosening both tension idler pulleys inside the spot film device.

Prepare the spot film device for storage by repacking it in its original shipping material whenever possible. If the original packing material is not available, use a heavy-duty corrugated cardboard carton or a wooden crate whose inside dimensions exceed those of the spot film device by at least 15% in all directions.

Before placing the spot film device in the container, cushion the bottom with no less than 2" (50mm) of foam padding, or other similar material. After centering the unit in the container, fill all empty spaces, including the top, with enough padding to prevent shifting. Finally, use a high quality tape to seal the container or nail it shut, as appropriate. Masking tape is NOT recommended with cardboard cartons because its adhesive often fails with age.

Avoid stacking heavy items on top of the container during storage to make sure the equipment is protected against damage.

9.3 STORAGE INFORMATION OF IMAGE INTENSIFIER

When the image intensifier system is not in use for an extended period of time or when it is being stored, it becomes necessary to "season" the intensifier tube. "Seasoning" is done by applying electrical current to the tube for a 24 hour period.

If the tube has been installed and has been idle for an extended period of time, i.e., 4 to 6 months, power can be applied to it through the spot film device. Check to make sure the power supply cord is connected to the spot film device control panel and then turn the power on and let it run for 24 hours before operating.

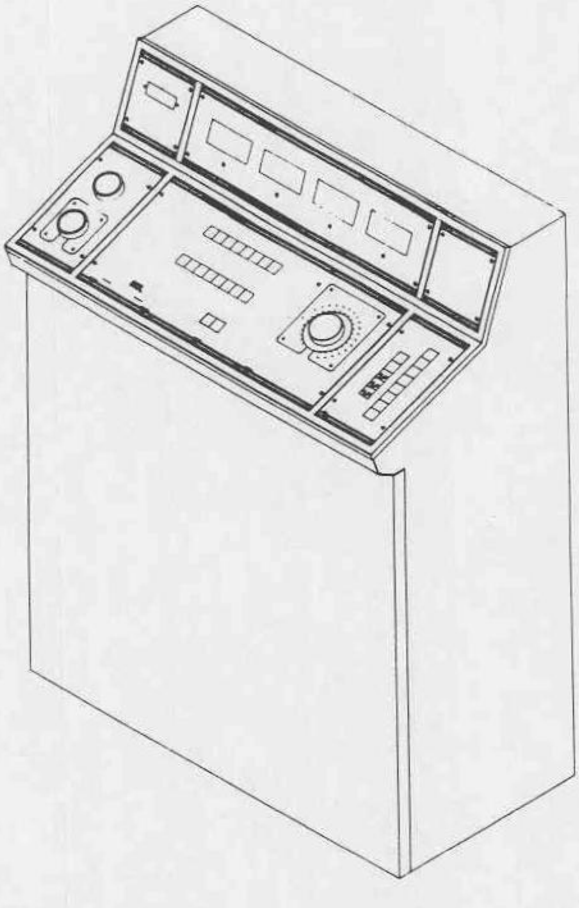
If the tube is being stored, it is recommended that the tube be "seasoned" every 6 months. Before installation, power can be applied by using the auxiliary power cord supplied with the system.

The auxiliary cord is equipped with a bulkhead receptacle which will accept the bulkhead plug on the power supply cord. Once the auxiliary cord and the power supply cord are connected, the auxiliary cord can be plugged into any 120V line. Allow current to run through the tube filament for 24 hours.

The maximum allowable storage period without seasoning is five (5) years. After extended storage (longer than one year), the image tube should be "seasoned" for a minimum of seventy-two (72) hours.

CHAPTER 6

GENERATOR



CHAPTER 6 - MXR-350 GENERATOR

TABLE OF CONTENTS

SECTION NUMBER **DESCRIPTION** **PAGE NUMBER**

SECTION 1 - GENERAL 1-1

1.1 SCOPE 1-1
1.2 DESCRIPTION 1-1
1.2.1 MAIN CONTROL 1-1
1.2.2 PROTECTIVE CIRCUITS 1-4
1.2.3 HIGH VOLTAGE TRANSFORMER 1-4
1.3 SPECIFICATIONS 1-5
1.4 ADJUSTMENTS AND CALIBRATION 1-6

SECTION 2 - CIRCUIT DESCRIPTION 2-1

2.1 POWER CIRCUIT, CIRCUIT FUNCTION DESCRIPTION (CFD) 1.0 2-1
2.2 HIGH VOLTAGE GENERATOR CIRCUIT, CFD 1.1 2-4
2.3 HIGH VOLTAGE GENERATOR INTERCONNECTIONS, CFD 1.1 2-6
2.4 CIRCUIT BREAKERS, CFD 1.2 2-7
2.5 LIGHT CIRCUIT, CFD 1.3 2-9
2.6 EXPOSURE CIRCUIT, CFD 2.0 2-11
2.7 MA OVERLOAD CIRCUIT, CFD 2.1 2-15
2.8 MA, TIME, & KVP OVERLOAD (TOLA) CIRCUIT, CFD 2.2 2-18
2.9 EXPOSURE END SIGNAL, CFD 2.4 2-21
2.10 EXPOSURE AND AUTOTIMER SAFETY CIRCUIT, CFD 2.6 2-23
2.11 FILAMENT CIRCUIT, CFD 3.0 2-25
2.12 SPACE CHARGE COMPENSATION, CFD 3.1 2-28
2.13 FILAMENT SELECTION, CFD 3.2 2-30
2.14 FILAMENT BOOST CIRCUIT, CFD 3.3 2-33
2.15 FLUORO RATE CONTROL, CFD 3.4 2-35
2.16 KVP METER CIRCUIT, CFD 4.0 2-38
2.16.1 RADIOGRAPHIC KVP 2-38
2.16.2 FLUOROSCOPIC KVP 2-39

TABLE OF CONTENTS (continued)

SECTION NUMBER	DESCRIPTION	PAGE NUMBER
2.17	MA METER & SHUNT CIRCUIT, CFD 5.0	2-41
2.18	MAS METER CIRCUIT, CFD 5.1	2-45
2.19	SINGLE PHASE IMPULSE TIMER CIRCUIT, CFD 6.0	2-47
2.20	TIME SELECTOR SWITCH	2-51
2.21	BACK-UP TIMER, CFD 6.2	2-52
2.22	SINGLE PHASE SCR CONTACTOR CIRCUIT, CFD 6.3	2-55
2.23	ROTOR CONTROL CIRCUIT, CFD 7.0	2-57
2.24	SPOT FILM CHANGEOVER CIRCUIT, CFD 8.1	2-61
2.25	AUTOTIMER DENSITY SELECTION	2-65
2.26	AUTOTIMER & BACK-UP TIMER INTERLOCK	2-65
2.27	AUTOTIMER RESET AND FIELD SELECTOR, CFD 9.0	2-66
2.28	AUXILIARY RELAY CIRCUIT, CFD 9.3	2-68
2.29	AUTOTIMER TECHNIQUE SELECTOR, CFD 9.4	2-70
SECTION 3 - MAINTENANCE		3-1
3.1	INTRODUCTION	3-1
3.2	PREVENTIVE (PERIODIC) MAINTENANCE	3-1
3.2.1	LINE SET ADJUSTMENTS	3-1
3.2.2	NINETY (90) DAY INSPECTION	3-4
3.2.3	TWELVE (12) MONTH INSPECTION.	3-5
3.2.4	OPERATIONAL TESTS	3-5
3.3	CORRECTIVE MAINTENANCE	3-6
3.3.1	GENERAL	3-6
3.3.2	HAND TOOLS REQUIRED	3-6
3.3.3	TEST EQUIPMENT	3-6
3.3.4	PARTS REPLACEMENT	3-7
SECTION 4 - MX-350 GENERATOR SIGNALS DESCRIPTION		4-1
SECTION 5 - PARTS LISTS		5-1

LIST OF FIGURES

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
1-1	RADIOGRAPHIC/FLUOROSCOPIC GENERATOR, MXR-350	1-2
1-2	MAIN CONTROL MXR-350, OPERATOR'S CONTROL PANEL	1-3
2-1	CFD 1.0	2-2
2-2	CFD 1.1	2-5
2-3	CFD 1.2	2-8
2-4	CFD 1.3	2-10
2-5	CFD 2.0	2-12
2-6	EXPOSURE INTERLOCK PCB	2-13
2-7	CFD 2.1	2-16
2-8	CFD 2.2	2-19
2-9	CFD 2.4	2-22
2-10	CFD 2.6	2-24
2-11	CFD 3.0	2-26
2-12	CFD 3.1	2-29
2-13	CFD 3.2	2-31
2-14	CFD 3.3	2-34
2-15	CFD 3.4	2-37
2-16	CFD 4.0	2-40
2-17	CFD 5.0	2-42
2-18	CFD 5.1	2-46
2-19	CFD 6.0	2-49
2-20	CFD 6.2	2-53
2-21	CFD 6.3	2-56
2-22	CFD 7.0	2-58
2-23	CFD 8.1	2-62
2-24	RELAY MATRIX PCB	2-63
2-25	CFD 9.0	2-67
2-26	CFD 9.3	2-69
2-27	CFD 9.4	2-71
3-1	CONSTANT CURRENT MULTIPLEX FILAMENT	3-3

LIST OF FIGURES (continued)

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
5-1	MXR-350 WIRING DIAGRAM	5-2
5-2	CONTROL ASM (PART 1) 5785.234.01	5-3
5-3	CONTROL ASM (PART 2) 5785.234.01	5-4
5-4	LAYOUT FOR 5184.234.03 MXR-350 AUX TECHNIQUE PNL ASM	5-12
5-5	SCHEMATIC FOR 5184.234.03 MXR-350 AUX TECHNIQUE PNL ASM	5-14
5-6	LAYOUT FOR 5184.234.0310 MXR-350 ION CHAMBER PKUP & DENSITY	5-15
5-7	SCHEMATIC FOR 5184.234.0310 MXR-350 ION CHAMBER PKUP & DENSITY	5-18
5-8	LAYOUT FOR 5184.234.0320 MXR-350 SPOT FILM CHANGEOVER PCB	5-19
5-9	SCHEMATIC FOR 5184.234.0320 MXR-350 SPOT FILM CHANGEOVER PCB	5-21
5-10	LAYOUT FOR 5184.234.04 MXR-350 MA TECH SELECT SWITCH ASM	5-22
5-11	SCHEMATIC FOR 5184.234.04 MXR-350 MA TECH SELECT SWITCH ASM	5-24
5-12	LAYOUT FOR 5184.234.0410 MXR-350 ION CHAMBER POWER-RESET-FIELD SWITCH	5-25
5-13	SCHEMATIC FOR 5184.234.0410 MXR-350 ION CHAMBER POWER-RESET-FIELD SWITCH	5-27
5-14	LAYOUT FOR 5184.234.0501 MXR-350 FLUORO MA CONTROL BOARD ASM	5-28
5-15	SCHEMATIC FOR 5184.234.0501 FLOURO MA CONTROL BOARD ASM	5-30
5-16	LAYOUT FOR 5184.234.06 MXR-350 TIMER SAFETY SWITCH ASM	5-31
5-17	SCHEMATIC FOR 5184.234.06 MXR-350 TIMER SAFETY SWITCH ASM	5-33
5-18	LAYOUT FOR 5184.234.0601 MXR-350 60 HZ IMPULSE TIMER RSTR ASM	5-34

LIST OF FIGURES (continued)

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
5-19	SCHEMATIC FOR 5184.234.0601 MXR-350 60 HZ IMPULSE TIMER RSTR ASM	5-36
5-20	LAYOUT FOR 5184.234.0690 MXR-350 UNIVERSAL TOLA RESISTOR ASM	5-37
5-21	SCHEMATIC FOR 5184.234.0690 MXR-350 UNIVERSAL TOLA RESISTOR ASM	5-39
5-22	LAYOUT FOR 5184.234.0698 MXR-350 BACKUP TIMER RESISTOR ASM	5-40
5-23	SCHEMATIC FOR 5184.234.0698 MXR-350 BACKUP TIMER RESISTOR ASM	5-42
5-24	LAYOUT FOR 5184.234.0699 MXR-350 50 HZ IMPULSE TIMER RESISTOR ASM	5-43
5-25	SCHEMATIC FOR 5184.234.0699 MXR-350 50 HZ IMPULSE TIMER RESISTOR ASM	5-45
5-26	LAYOUT FOR 5184.234.08 MXR-350 PREP/EXP PANEL ASM	5-46
5-27	SCHEMATIC FOR 5184.234.08 MXR-350 PREP/EXP PANEL ASM	5-48
5-28	LAYOUT FOR 5184.234.09 MXR-350 FLUORO KVP METER SHUNT ASM	5-49
5-29	SCHEMATIC FOR 5184.234.09 MXR-350 FLUORO KVP METER SHUNT ASM	5-51
5-30	LAYOUT FOR 5184.234.10 MXR-350 FLUORO EXPOSURE INDICATOR ASM	5-52
5-31	SCHEMATIC FOR 5184.234.10 MXR-350 FLUORO EXPOSURE INDICATOR ASM	5-54
5-32	LAYOUT FOR 5184.234.11 MXR-350 SFD PREP DELAY RELAY ASM	5-55
5-33	SCHEMATIC FOR 5184.234.11 MXR-350 SFD PREP DELAY RELAY ASM	5-57
5-34	LAYOUT FOR 5184.234.12 MXR-350 SINGLE PHASE IMPULSE TIMER ASM	5-58
5-35	SCHEMATIC FOR 5184.234.12 MXR-350 SINGLE PHASE IMPULSE TIMER ASM	5-61
5-36	LAYOUT FOR 5184.234.19 MXR-350 FILAMENT DRIVE TRANSISTOR ASM	5-62

LIST OF FIGURES (continued)

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
5-37	SCHEMATIC FOR 5184.234.19 MXR-350 FILAMENT DRIVE TRANSISTOR ASM	5-64
5-38	LAYOUT FOR 5184.234.2901 MXR-350 24 VDC EXP END BUZZ ASM	5-65
5-39	SCHEMATIC FOR 5184.234.2901 MXR-350 24 VDC EXP END BUZZ ASM	5-67
5-40	LAYOUT FOR 5281.234.02 MXR-350 TIMER SWITCH ASM	5-68
5-41	LAYOUT FOR 5284.234.1102 MXR-350 235A 800V IMPULSE TIMER /CONTACTOR	5-70
5-42	LAYOUT FOR 5284.234.15 MXR-350 3P FILAMENT RESISTOR PNL ASM	5-72
5-43	SCHEMATIC FOR 5284.234.15 MXR-350 3P FILAMENT RESISTOR PNL ASM	5-74
5-44	LAYOUT FOR 5285.234.01 MXR-350 3P FILAMENT DRIVE COOLING ASM	5-75
5-45	LAYOUT FOR 5285.234.02 MXR-350 CONSTANT VOLTAGE TRANSFORMER ASM	5-77
5-46	LAYOUT FOR 5285.234.03 MXR-350 RESISTOR PANEL ASM	5-79
5-47	LAYOUT FOR 5286.234.04 MXR-350 AUX PWR SUPPLY 50/60 HZ XFNR ASM	5-81
5-48	LAYOUT FOR 5286.234.05 MXR-350 FIL XFMR SUPPLY ASM 50/60 HZ	5-83
5-49	LAYOUT FOR 5485.234.01 MXR-350 TAP SWITCHES PANEL ASM	5-85
5-50	LAYOUT FOR 5585.234.02 MXR-350 CONTACTOR PANEL ASM	5-87
5-51	LAYOUT FOR 6184.234.0803 MXR-350 MAS METER CURRENT INTEGRATOR ASM	5-90
5-52	SCHEMATIC FOR 6184.234.0803 MXR-350 MAS METER CURRENT INTEGRATOR ASM	5-93
5-53	LAYOUT FOR 6284.234.01 MXR-350 UNIVERSAL TOLA ASM	5-94
5-54	SCHEMATIC FOR 6284.234.01 MXR-350 UNIVERSAL TOLA ASM	5-97

LIST OF FIGURES (continued)

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
5-55	LAYOUT FOR 6284.234.02 MXR-350 AUX RELAY PNL ASM	5-98
5-56	SCHEMATIC FOR 6284.234.02 MXR-350 AUX RELAY PNL ASM	5-100
5-57	LAYOUT FOR 6284.234.03 MXR-350 KVP COMPENSATION PNL ASM	5-101
5-58	SCHEMATIC FOR 6284.234.03 MXR-350 KVP COMPENSATION PNL ASM	5-103
5-59	LAYOUT FOR 6284.234.04 MXR-350 EXP INTERLOCK PNL ASM	5-104
5-60	SCHEMATIC FOR 6284.234.04 MXR-350 EXP INTERLOCK PNL ASM	5-107
5-61	LAYOUT FOR 6284.234.0803 MXR-350 BACKUP TIMER PANEL ASM	5-108
5-62	SCHEMATIC FOR 6284.234.0803 MXR-350 BACKUP TIMER PANEL ASM	5-111
5-63	LAYOUT FOR 6284.234.09 MXR-350 ROTOR CONTROL W/PHOTOTRANSISTORS	5-112
5-64	SCHEMATIC FOR 6284.234.09 MXR-350 ROTOR CONTROL W/PHOTOTRANSISTORS	5-116
5-65	LAYOUT FOR 6284.234.1009 MXR-350 CONSTANT CURRENT FILAMENT CONTROL ASM	5-117
5-66	SCHEMATIC FOR 6284.234.1009 MXR-350 CONSTANT CURRENT FILAMENT CONTROL ASM	5-121
5-67	LAYOUT FOR 6284.234.11 MXR-350 SCR CONTACTOR TIMER INTERFACE	5-122
5-68	SCHEMATIC FOR 6284.234.11 MXR-350 SCR CONTACTOR TIMER INTERFACE	5-125
5-69	LAYOUT FOR 6284.234.12 MXR-350 MA-KVP-LINE METER SHUNT ASM	5-126
5-70	SCHEMATIC FOR 6284.234.12 MXR-350 MA-KVP-LINE METER SHUNT ASM	5-128
5-71	LAYOUT FOR 6584.234.01 MXR-350 RELAY MATRIX ASM	5-129

LIST OF FIGURES (continued)

FIGURE NUMBER	DESCRIPTION	PAGE NUMBER
5-72	SCHEMATIC FOR 6584.234.01 MXR-350 RELAY MATRIX ASM	5-131
5-73	LAYOUT FOR 5184.323.02 75 KVP PLUG IN RECTIFIER ASM	5-132
5-74	SCHEMATIC FOR 5184.323.02 75 KVP PLUG IN RECTIFIER ASM	5-134
5-75	LAYOUT FOR 5484.323.02 PLUG-IN HV DIODE BRIDGE ASM	5-135
5-76	LAYOUT FOR 6360.009 150 KV PLUG-IN RECTIFIER ASM	5-137
5-77	ASSEMBLY DRAWING FOR 5786.323.03 MIL 2-TUBE HV TRANSFORMER TOP ASM	5-139
5-78	LAYOUT FOR 6635.300 TRANSFORMER ASSEMBLY	5-142

LIST OF TABLES

TABLE NUMBER	DESCRIPTION	PAGE NUMBER
2-1	AUTOTRANSFORMER TERMINAL VOLTAGES	2-3
2-2	GENERATOR CABLE FUNCTIONS	2-6
2-3	CIRCUIT BREAKER FUNCTIONS	2-7
3-1	LINE SET ADJUSTMENTS	3-2
5-1	PARTS LIST FOR 5785.234.01 MXR-350 CONTROL	5-5
5-2	PARTS LIST FOR 5184.234.03 MXR-350 AUX TECHNIQUE PANEL ASM	5-13
5-3	PARTS LIST FOR 5184.234.0310 MXR-350 ION CHAMBER PKUP & DENSITY	5-16
5-4	PARTS LIST FOR 5184.234.0320 MXR-350 SPOTFILM CHANGEOVER PCB	5-20
5-5	PARTS LIST FOR 5184.234.04 MXR-350 MA TECH SELECT SWITCH ASM	5-23
5-6	PARTS LIST FOR 5184.234.0410 MXR-350 ION CHAMBER POWER-RESET-FIELD SWITCH	5-26
5-7	PARTS LIST FOR 5184.234.0501 MXR-350 FLUORO MA CONTROL BOARD ASM	5-29
5-8	PARTS LIST FOR 5184.234.06 MXR-350 TIMER SAFETY SWITCH ASM	5-32
5-9	PARTS LIST FOR 5184.234.0601 MXR-350 60 HZ IMPULSE TIMER RSTR ASM	5-35
5-10	PARTS LIST FOR 5184.234.0690 MXR-350 UNIVERSAL TOLA RESISTOR ASM	5-38
5-11	PARTS LIST FOR 5184.234.0698 MXR-350 UNIVERSAL BACKUP TIMER RESISTOR ASM	5-41
5-12	PARTS LIST FOR 5184.234.0699 MXR-350 50 HZ IMPULSE TIMER RESISTOR ASM	5-44
5-13	PARTS LIST FOR 5184.234.08 MXR-350 PREPARE/EXPOSE PANEL ASM	5-47
5-14	PARTS LIST FOR 5184.234.09 MXR-350 FLUORO KVP METER SHUNT ASM	5-50
5-15	PARTS LIST FOR 5184.234.10 MXR-350 FLUORO EXPOSURE INDCTR ASM	5-53

LIST OF TABLES (continued)

TABLE NUMBER	DESCRIPTION	PAGE NUMBER
5-16	PARTS LIST FOR 5184.234.11 MXR-350 SFD PREP DELAY RELAY ASM	5-56
5-17	PARTS LIST FOR 5184.234.12 MXR-350 SINGLE PHASE IMPULSE TIMER ASM	5-59
5-18	PARTS LIST FOR 5184.234.19 MXR-350 FILAMENT DRIVE TRANSISTOR ASM	5-63
5-19	PARTS LIST FOR 5184.234.2901 MXR-350 24VDC EXPOSURE END BUZZ ASM	5-66
5-20	PARTS LIST FOR 5281.234.02 MXR-350 TIMER SWITCH ASM	5-69
5-21	PARTS LIST FOR 5284.234.1102 MXR-350 235A 800V IMPULSE TIMER/CONTACTOR	5-71
5-22	PARTS LIST FOR 5284.234.15 MXR-350 3P FILAMENT RESISTOR PNL ASM	5-73
5-23	PARTS LIST FOR 5285.234.01 MXR-350 3P FILAMENT DRIVE COOLING ASM	5-76
5-24	PARTS LIST FOR 5285.234.02 CONSTANT VOLTAGE TRANSFORMER ASM	5-78
5-25	PARTS LIST FOR 5285.234.03 MXR-350 RESISTOR PANEL ASM	5-80
5-26	PARTS LIST FOR 5286.234.04 AUX PWR SUPPLY 50/60 HZ XFMR ASM	5-82
5-27	PARTS LIST FOR 5286.234.05 FIL. XFMR SUPPLY ASM 50/60 HZ	5-84
5-28	PARTS LIST FOR 5485.234.01 MXR-350 TAP SWITCHES PANEL ASM	5-86
5-29	PARTS LIST FOR 5585.234.02 MXR-350 CONTACTOR PANEL ASM	5-88

LIST OF TABLES (continued)

TABLE NUMBER	DESCRIPTION	PAGE NUMBER
5-30	PARTS LIST FOR 6184.234.0803 MXR-350 MAS METER CURRENT INTEGRATOR ASM	5-91
5-31	PARTS LIST FOR 6284.234.01 MXR-350 UNIVERSAL TOLA ASSEMBLY	5-95
5-32	PARTS LIST FOR 6284.234.02 MXR-350 AUXILIARY RELAY PANEL ASM	5-99
5-33	PARTS LIST FOR 6284.234.03 MXR-350 KVP COMPENSATION PANEL ASM	5-102
5-34	PARTS LIST FOR 6284.234.04 MXR-350 EXPOSURE INTERLOCK PANEL ASM	5-105
5-35	PARTS LIST FOR 6284.234.0803 MXR-350 BACKUP TIMER PANEL ASM	5-109
5-36	PARTS LIST FOR 6284.234.09 MXR-350 ROTOR CONTROL WITH PHOTOTRANSISTORS	5-113
5-37	PARTS LIST FOR 6284.234.1009 MXR-350 CONSTANT CURRENT FILAMENT CONTROL ASM	5-118
5-38	PARTS LIST FOR 6284.234.11 MXR-350 SCR CONTACTOR-TIMER INTERFACE	5-123
5-39	PARTS LIST FOR 6284.234.12 MXR-350 MA-KVP-LINE METER SHUNT ASM	5-127
5-40	PARTS LIST FOR 6584.234.01 MXR-350 RELAY MATRIX ASM	5-130
5-41	PARTS LIST FOR 5184.323.02 75 KVP PLUG-IN RECTIFIER ASM	5-133
5-42	PARTS LIST FOR 5484.323.02 PLUG-IN HV DIODE BRIDGE ASM	5-136
5-43	PARTS LIST FOR 6360.009 150 KV PLUG-IN RECTIFIER ASM	5-138
5-44	PARTS LIST FOR 5786.323.03 MILITARY 2-TUBE HV TRANSFORMER TOP ASM	5-140
5-45	PARTS LIST FOR 6632.300 TRANSFORMER ASSEMBLY	5-143

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CHAPTER 6 - MXR-350 GENERATOR

SECTION 1 - GENERAL

1.1 SCOPE

This chapter describes the theory of operation and maintenance of the Continental X-ray Corporation Model MXR-350 Radiographic/Fluoroscopic Generator. This generator is only part of a diagnostic x-ray system. Other components are also required to form a complete system. Since these components are the subjects of their own chapters, they will not be discussed, except as their functions apply to the generator.

It is assumed that all installation, operating, and maintenance personnel are qualified to perform their assigned functions. This includes becoming familiar with the contents of this chapter because it contains information needed for compliance with Center for Devices & Radiological Health (CDRH) regulations.

Installation and calibration procedures are subjects of their own chapters.

1.2 DESCRIPTION

The Continental X-Ray Corporation (CXC) Model MXR-350 Radiographic/Fluoroscopic Generator (FIGURE 1-1), is a single phase, full wave rectified generator for operating two (2) dual focus, rotating anode x-ray tubes. One (1) of these tubes is used for Over-Table techniques while the second is mounted under the table for use with a Spot Film Device (SFD). Versatility and flexibility make the generator adaptable to a variety of systems and applications. The generator consists of two (2) units: the Main Control and the High Voltage Transformer.

1.2.1 MAIN CONTROL (FIGURE 1-2)

Generator operation is directed from the main control unit. All controls and indicators are located on the front of its cabinet. Most of these controls are large, illuminated, single action push button switches. These push buttons enable operators to make accurate function, mA, and Autotimer selections while major kVp, minor kVp, coarse and fine line adjustments, and fluoro kVp adjustment are rotary controls. The generator is also capable of autotiming.

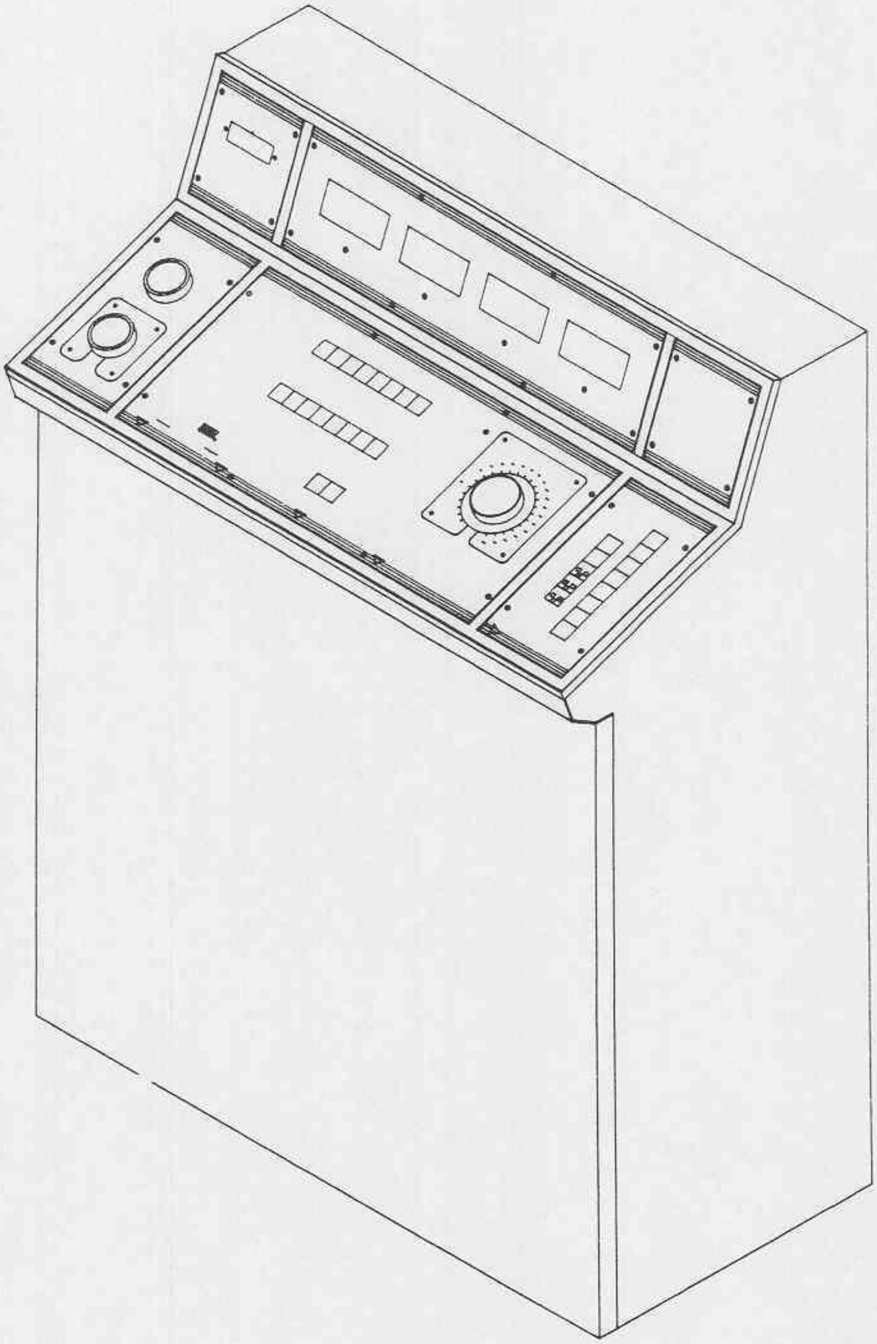

FIGURE 1-1 RADIOGRAPHIC/FLUOROSCOPIC GENERATOR, MXR-350

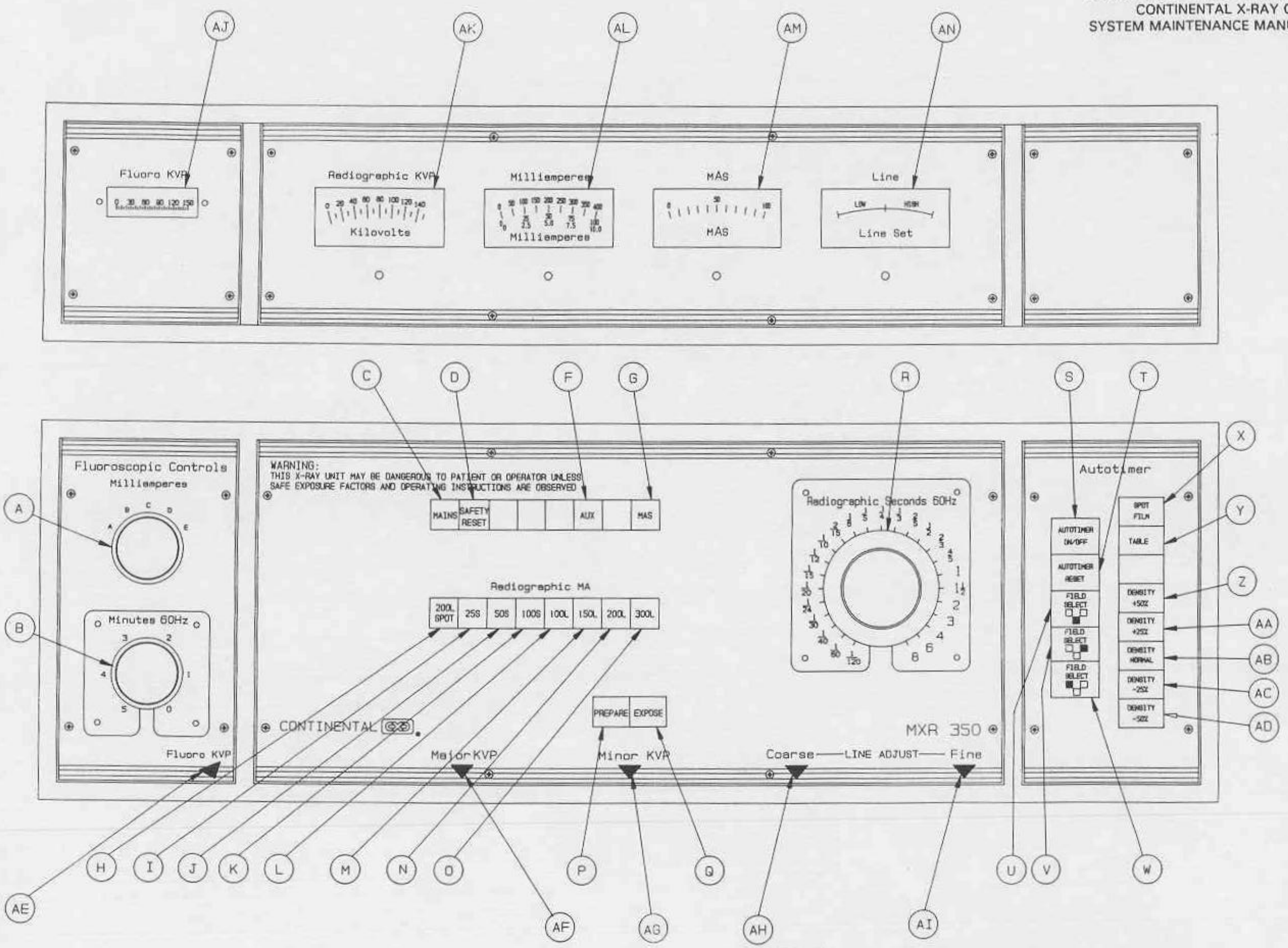
AJ
AK
AL
AM
AN
Fluoro KVP
Radiographic KVP
Kilovolts
Milliamperes
Milliamperes
MAS
MAS
Line
LOW
HIGH
Line Set
C
D
F
G
R
S
T
X
Y
Z
AA
AB
AC
AD
Fluoroscopic Controls
Milliamperes
A
B
C
D
E
Minutes 60Hz
Fluoro KVP
WARNING:
THIS X-RAY UNIT MAY BE DANGEROUS TO PATIENT OR OPERATOR UNLESS
SAFE EXPOSURE FACTORS AND OPERATING INSTRUCTIONS ARE OBSERVED
MAINS
SAFETY RESET
AUX
MAS
Radiographic MA
200L SPOT
25S
50S
100S
100L
150L
200L
300L
CONTINENTAL
PREPARE
EXPOSE
Major KVP
Minor KVP
Radiographic Seconds 60Hz
MXR 350
Coarse
LINE ADJUST
Fine
Autotimer
AUTOTIMER ON/OFF
AUTOTIMER RESET
FIELD SELECT
FIELD SELECT
FIELD SELECT
SPOT FILM
TABLE
DENSITY +50%
DENSITY +25%
DENSITY NORMAL
DENSITY -25%
DENSITY -50%
H
I
J
K
L
M
N
O
P
Q
U
V
W
AE
AF
AG
AH
AI

FIGURE 1-2 MAIN CONTROL MXR-350, OPERATOR'S CONTROL PANEL

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FIGURE 1-2 MAIN CONTROL MXR-350, OPERATOR'S CONTROL PANEL

1.2.2 PROTECTIVE CIRCUITS

Circuitry for protecting the x-ray tubes against overloads is located in the main control. This circuitry prevents tube overloading by locking out exposure factors whose products exceed the heat unit capacity of the focal spot being used. It also notifies the operator that the selected exposure factors are locked out by illuminating the SAFETY RESET (FIGURE 1-2) light on the front panel.

1.2.3 HIGH VOLTAGE TRANSFORMER

The high voltage transformer contains the circuitry needed for the operation and control of two (2) x-ray tubes and their focal spots, as determined by the main control. This includes solid state rectifiers for converting high tension AC to full wave, rectified high tension DC, and a motor driven high voltage changeover switch.

A separate filament transformer is provided for each focal spot of each tube.

The transformer is constructed to provide a balanced output under all load conditions. However, an unbalance monitoring circuit prevents tube damage by disabling the generator so that exposures cannot be made if an unbalanced condition occurs. When an unbalanced condition occurs during an exposure, this circuit immediately terminates the exposure and the SAFETY RESET lamp is illuminated on the front panel.

1.3 SPECIFICATIONS

- **PHYSICAL DIMENSIONS**

Main Control	48-1/2"H X 33"W X 18"D
	(1232mm X 838mm X 457 mm)
High Voltage Transformer	26"H X 29"L X 16"W
	(660mm X 737mm X 406mm)

Shipping Weight (approximate):

Main Control	484 lb.
High Voltage Transformer	706 lb.

- **ELECTRICAL**

Power Requirements	240VAC (nominal), 132A., 50/60Hz
Voltage Range	190 - 270VAC
Output Power	
Maximum (300mA at 150kVp)	45,000W

1.3 SPECIFICATIONS (continued)

- **OPERATIONAL**

mA Selection	
Small Focal Spot	25mA, 50mA, 100mA
Large Focal Spot	100mA, 150mA, 200mA, 300mA
kVp Selection	
Total Range	40 - 150kVp
Radiographic	kVp Major 10KV steps kVp Minor 1.7KV steps (approximately)
Fluoroscopic	kVp continuously variable from 55KV to 125KV.
Time Selection	(seconds - 60Hz) 1/120, 1/60, 1/40, 1/30, 1/24, 1/20, 1/15, 1/12, 1/10, 2/15, 1/6, 1/5, 1/4, 1/3, 2/5, 1/2, 2/3, 4/5, 1, 1-1/2, 2, 3, 4, 6, 8
Time Selection	(seconds - 50Hz) 1/100, 1/50, 3/100, 1/25, 1/20, 3/50, 2/25, 1/10, 3/25, 3/20, 1/5, 1/4, 3/10, 2/5, 1/2, 3/5, 4/5, 1, 1-1/2, 2, 3, 4, 6, 8

1.4 ADJUSTMENTS AND CALIBRATION

Refer to Chapter 3 for complete adjustment and calibration procedures.

WARNING

UNGROUNDED METAL PARTS OF AN X-RAY SYSTEM CAN EASILY REACH ELECTRICAL POTENTIALS THAT CAN CAUSE DANGEROUS, POSSIBLY FATAL,ELECTRICAL SHOCKS. IT IS VITAL TO ENSURE, THAT ALL EXPOSED METAL PARTS, ESPECIALLY THOSE SURROUNDING HIGH VOLTAGE COMPONENTS, ARE SOLIDLY CONNECTED TO A KNOWN EARTH GROUND AT THE SAME POINT, USING COPPER WIRE NO SMALLER THAN AWG 18.

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SECTION 2 - CIRCUIT DESCRIPTION

2.1 POWER CIRCUIT, CIRCUIT FUNCTION DESCRIPTION (CFD) 1.0 (FIGURE 2-1)

The MXR-350 X-ray Generator receives it power via the factory supplied line cable which is connected into disconnect box "B" as follows: L1 (BLK), L2 (WHT) and G (GRN). The main supply necessary for safe and normal operation of the generator must be between 190 volts and 270 volts, single phase, and 50 Hz/60 Hz.

The "NO-LOAD" to "FULL-LOAD" line regulation must be less than a 8% change, as measured in the main disconnect box "B".

In the control, L1 (BLK) AND L2 (WHT) connect to parallel contacts, to reduce the contact resistance of Re-20 which is the line contactor. The G (GRN) conductor in the line cable connects to a grounding stud on the control chassis.

At the line contactor Re-20, L1 becomes T1 and L2 becomes T2. Both T1 and T2 connect to the autotransformer through compensation switches. Lead T1 connects via Line Comp Coarse to terminals A1 through A6. T2 connects via the Line Comp Fine to terminals A14, through A20, to cover input voltage required.

It is required that the transformer be connected as close as possible to the incoming line voltage for proper and safe operation of the x-ray system.

The line contactor Re-20 is initially supplied voltage via the MAINS push button switch and L1 and L2. A tap from L1 is fused by F1, becomes L1P, through circuit breaker CB26, becomes L1F across the MAINS push button switch, and becomes CL1 to one side of the coil for Re-20, through a normally closed pole of relay Re-1 on the Rotor Control board.

A tap from L2 is fused by F2, becomes L2P, through circuit breaker CB27, becomes L2F, through another normally closed pole of Re-1 on the other side of the coil for Re-20.

Depressing the MAINS push button switch will apply the incoming line voltage to Re-20, closing its contacts, and supply the autotransformer with incoming power. Inside the MAINS push button switch is a lamp which will illuminate when the switch is closed.

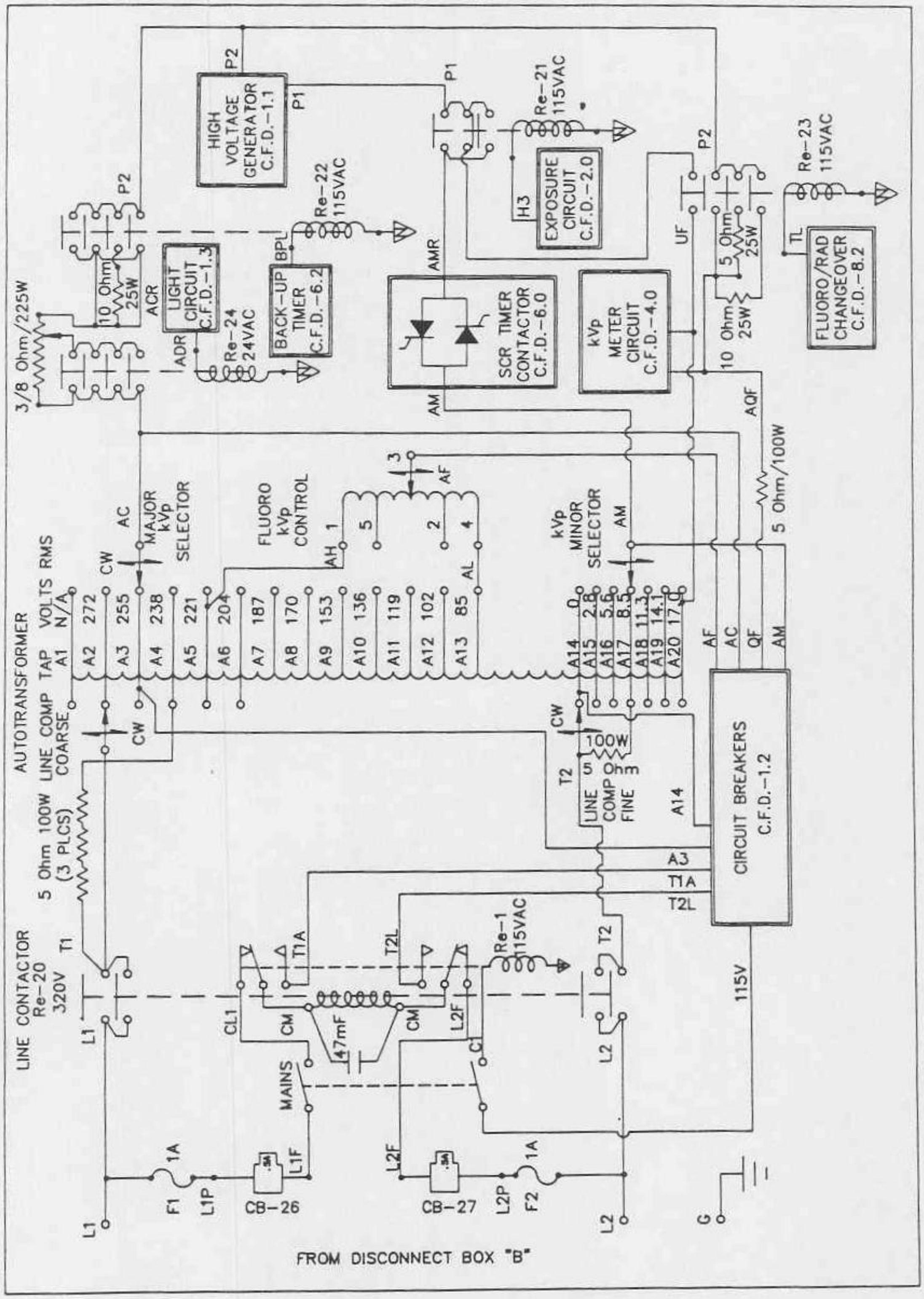

HIGH VOLTAGE GENERATOR C.F.D.-1.1
P1
P2
3/8 Ohm/225W
10 Ohm 25W
ACR
ADR
LIGHT CIRCUIT C.F.D.-1.3
Re-24 24VAC
BACK-UP TIMER C.F.D.-6.2
BPL
Re-22 115VAC
SCR TIMER CONTACTOR C.F.D.-6.0
AMR
AM
Re-21 115VAC
H3
EXPOSURE CIRCUIT C.F.D.-2.0
kVp METER CIRCUIT C.F.D.-4.0
UF
5 Ohm 25W
10 Ohm 25W
Re-23 115VAC
TL
FLUORO/RAD CHANGEOVER C.F.D.-8.2
AQF
5 Ohm/100W
AUTOTRANSFORMER
LINE COMP COARSE
TAP
VOLTS RMS
A1 N/A
A2 272
A3 255
A4 238
A5 221
A6 204
A7 187
A8 170
A9 153
A10 136
A11 119
A12 102
A13 85
A14 0
A15 2.8
A16 5.6
A17 8.5
A18 11.3
A19 14.1
A20 17.0
CW
AC
MAJOR kVp SELECTOR
FLUORO kVp CONTROL
AH
AL
AF
1
2
3
4
5
kVp MINOR SELECTOR
AF
AC
QF
AM
5 Ohm 100W (3 PLCS)
LINE CONTACTOR Re-20 320V
T1
T2
LINE COMP FINE
100W
5 Ohm
A14
A3
T1A
T2L
CIRCUIT BREAKERS C.F.D.-1.2
115V
L1
L2
CL1
CM
47mF
T1A
T2L
L2F
C1
Re-1 115VAC
MAINS
L1F
L2F
1A
F1
F2
L1P
L2P
CB-26
CB-27
G
FROM DISCONNECT BOX "B"

FIGURE 2-1 CFD 1.0

2.1 POWER CIRCUIT (continued)

Taps from the autotransformer A3 and A14 supply the Auxiliary Power Transformer (CFD 1.2), with a constant 240 VAC.

Taps $A\overset{5}{4}$ and A13 supply 128 VAC for the fluoro kVp control.

Lead AC is the common of the major kVp selector switch and connects to one side of the 0.375 Ω (3/8 Ω) damping resistor. A portion of this resistor is shunted by contactor Re-24. When low mA stations (below 200 mA) are selected, full 0.375 Ω resistor is inserted in series with P2 lead to the high tension transformer to prevent "ringing" in the high tension wave form. When either 200 mA or 300 mA stations are selected the contactor Re-24 is closed and only 0.075 Ω is inserted.

When the autotransformer is energized, 115 VAC is generated, which closes relay Re-1. The coil of relay Re-20, Main Contactor, now transfers to the normally open/now closed poles of Re-1 which are supplied via T1A and T2L with 240 VAC.

The kVp selection is via leads A1 and A15 from the autotransformer. Lead AM at this point supplies voltage to the SCR Timer Contactor for radiographic exposures. This output of the SCR Timer Contactor supplies P1 to the high tension transformer.

Leads AC and AM in conjunction with circuit breakers CB23 and CB24 supply the kVp Meter Circuit (CFD 1.2).

The autotransformer is connected to the major kVp selector via taps A1 through A13, and to the minor kVp selector via taps A14 through A20. All voltages from the autotransformer can be measured at the terminals of the major and minor kVp selectors. TABLE 2-1 lists the autotransformer terminals and the voltage at that terminals with respect to terminal A14.

AC to AM = 288 VAC
A1 = N/A VAC
A2 = 272 VAC
A3 = 255 VAC
A4 = 238 VAC
A5 = 221 VAC
A6 = 204 VAC
A7 = 187 VAC
A8 = 170 VAC
A9 = 153 VAC
A10 = 136 VAC
A11 = 119 VAC
A12 = 102 VAC
A13 = 85 VAC
A14 = 0 VAC
A15 = 2.8 VAC
A16 = 5.6 VAC
A17 = 8.5 VAC
A18 = 11.3 VAC
A19 = 14.1 VAC
A20 = 17.0 VAC

ALL VOLTAGES SHOULD BE WITHIN ± 2%.

TABLE 2-1 AUTOTRANSFORMER TERMINAL VOLTAGES

2.2 HIGH VOLTAGE GENERATOR CIRCUIT, CFD 1.1 (FIGURE 2-2)

The control is connected to the high voltage (tension) transformer via two (2) factory supplied interconnecting cables. One (1) cable is terminated into a heavy three (3) pin connector J23 supplying primary power to the high tension transformer. The other cable is terminated into a twelve (12) pin connector J22 which supplies the control with information from the high tension transformer and also transmits information from the control concerning tube selection and technique to the high tension transformer.

In addition to the high tension transformer, the high voltage generator includes the anode bridge, cathode bridge, unbalance monitor, thyrites for over voltage protection, filament transformers for the over-table and under-table x-ray tubes, the changeover switch motor and switch assemblies, and the socket wells for both x-ray tubes. All components are housed in a large oil filled metal tank.

In the control, the main generator cable and the auxiliary generator cable terminate into the terminal strip. TABLE 2-2 shows the connector pin designation and function of both cables.

Even though the high voltage generator contains one (1) high tension transformer, it can accommodate two (2) x-ray tubes. This is accomplished through the use of the changeover switch. This switch connects only the high voltage to the desired x-ray tube, either over-table or under-table. While one (1) x-ray tube is connected to the diode bridges, **the other x-ray tube is at ground potential.**

The appropriate x-ray tube filaments are energized by selection in the control of its energizing filament transformer. Filament power is supplied to XLO for the large over-table filament, XSO for the small over-table filament, XLU for the large under-table filament and XSU for the small under-table filament.

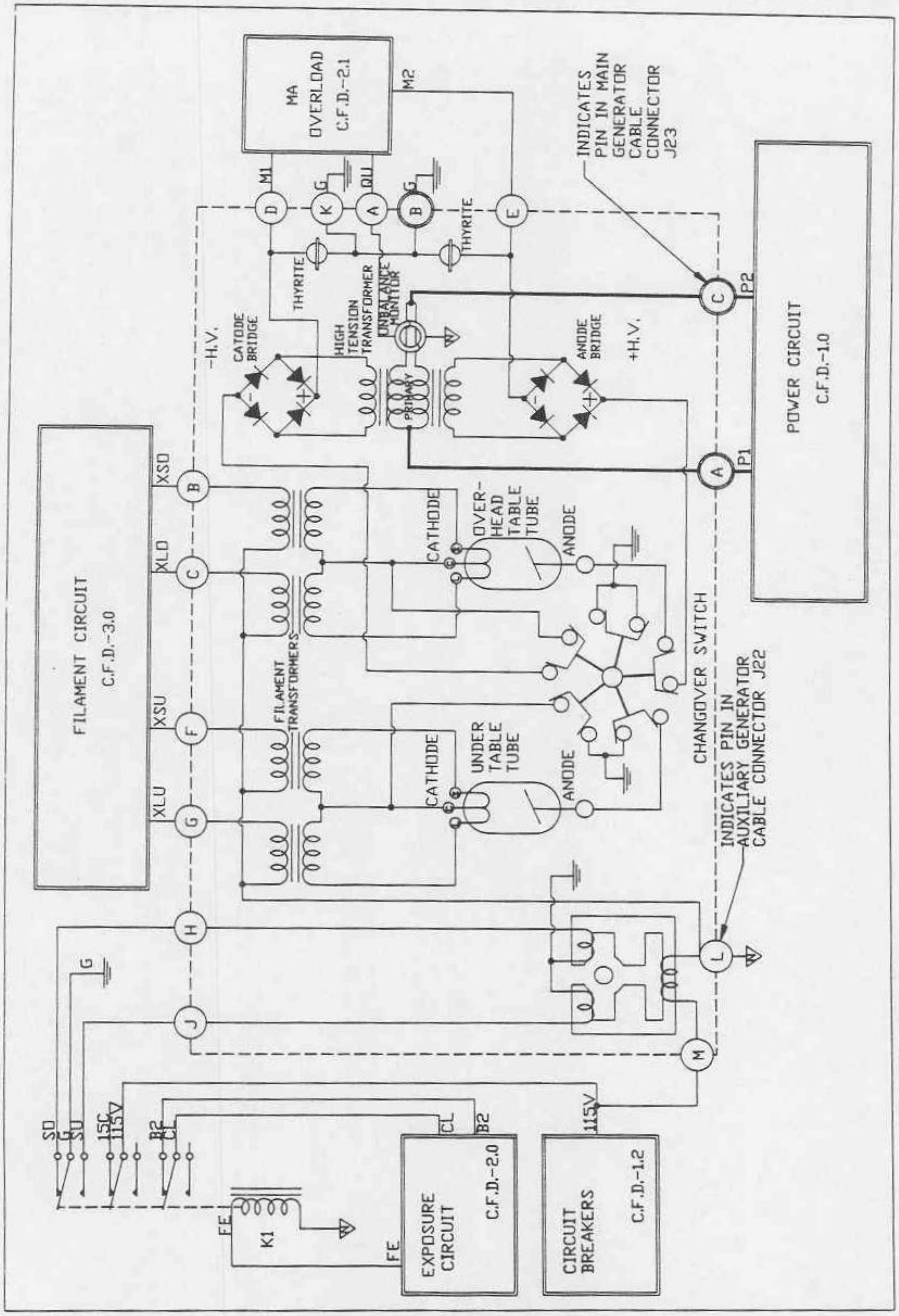

MA
OVERLOAD
C.F.D.-2.1
M1
M2
OU
G
G
D
K
A
B
E
THYRITE
THYRITE
INDICATES PIN IN MAIN GENERATOR CABLE CONNECTOR J23
POWER CIRCUIT
C.F.D.-1.0
C
P2
A
P1
-H.V.
CATODE BRIDGE
HIGH TENSION TRANSFORMER
UNBALANCE MONITOR
PRIMARY
ANODE BRIDGE
+H.V.
FILAMENT CIRCUIT
C.F.D.-3.0
XSO
XLO
XSU
XLU
B
C
F
G
CATHODE
OVER-HEAD TABLE TUBE
ANODE
FILAMENT TRANSFORMERS
CHANGEOVER SWITCH
CATHODE
UNDER TABLE TUBE
ANODE
INDICATES PIN IN AUXILIARY GENERATOR CABLE CONNECTOR J22
H
J
L
M
G
SD
G
SU
15C
115V
B2
CL
CL
B2
115V
EXPOSURE CIRCUIT
C.F.D.-2.0
CIRCUIT BREAKERS
C.F.D.-1.2
FE
FE
K1

FIGURE 2-2 CFD 1.1

2.3 HIGH VOLTAGE GENERATOR INTERCONNECTIONS, CFD 1.1

AUXILIARY GENERATOR CABLE, J22

PIN	FUNCTION
A	(QU) Primary unbalance monitor output to mA Overload Circuit.
B	(XSO) One side of the primary for the filament transformer for the small filament in the over-table x-ray tube.
C	(XLO) One side of the primary for the filament transformer for the large filament in the over-table x-ray tube.
D	(M1) Current output from the cathode bridge to the mA Overload Circuit.
E	(M2) Current output from the anode bridge to the mA Overload Circuit.
F	(XSU) One side of the primary for the filament transformer for the small filament in the under-table x-ray tube.
G	(XLU) One side of the primary for the filament transformer for the large filament in the under-table x-ray tube.
H	(SO) Ground side of the stator winding for the changeover switch for selecting the over-table x-ray tube.
J	(SU) Ground side of the stator winding for the changeover switch for selecting the under-table x-ray tube.
K	(G) Ground point for auxiliary generator cable
L	(N) Common point for the primaries of all filament transformers and return side of the field winding for the changeover switch.
M	(115V) Supply lead for the field winding of the changeover switch.

MAIN GENERATOR CABLE, J23

PIN	FUNCTION
A	(P1) Primary side of high tension transformer
B	(G) Ground for main generator cable
C	(P2) Primary side of high tension transformer

TABLE 2-2 GENERATOR CABLE FUNCTIONS

2.4 CIRCUIT BREAKERS, CFD 1.2 (FIGURE 2-3)

All electronic circuits in the x-ray system are protected by the extensive use of circuit breakers. In some instances, fuses are also used in conjunction with circuit breakers as required by certification laboratories. All circuit breakers and fuses in the main control are located on the left side panel when facing the front. TABLE 2-3 lists each circuit breaker by number and the circuit it protects.

CIRCUIT BREAKER	DESCRIPTION	FUNCTION
CB1	230V	230 VAC buss.
CB2	H2F	230 VAC to Rotor Control.
CB3	115V	115 VAC buss, Constant Voltage Transformer (CVT), fan, high voltage generator, and kVp Meter Circuit and mAs Meter Circuit.
CB4	60V	60 VAC to Rotor Control.
CB5	24V	24 VAC mAs Meter Circuit, Light Circuit, Impulse Timer, Exposure Circuit and Exposure End Circuitry.
CB7	24BT	24 VAC to Back-up Timer.
CB9	115F	115 VAC to Exposure Circuit, mA kVp and Time Limiting Circuit, Autotimer Selector and mA Overload Circuit.
CB10	15IT	115 VAC to Impulse Timer.
CB11	15MS	115 VAC to mAs Meter Circuit.
CB12	XSP	115 VAC from CVT to Filament Circuit.
CB14	QF	Voltage from wiper of fluoro variac (AF) to fluoro damping resistor (5 Ω/100 W)
CB17	T1A	Voltage from autotransformer A3 to one side of auxiliary power transformer.
CB18	T2L	Voltage from autotransformer A14 to one side of to one side of the auxiliary power transformer.
CB23	AMW	One side of supply to kVp Meter Circuit.
CB24	ACKM	One side of supply to kVp Meter Circuit.
CB26	L1F	One side of line to MAINS switch (CFD 1.0).
CB27	L2F	One side of line to MAINS Transfer Relay (CFD 1.0).

TABLE 2-3 CIRCUIT BREAKER FUNCTIONS

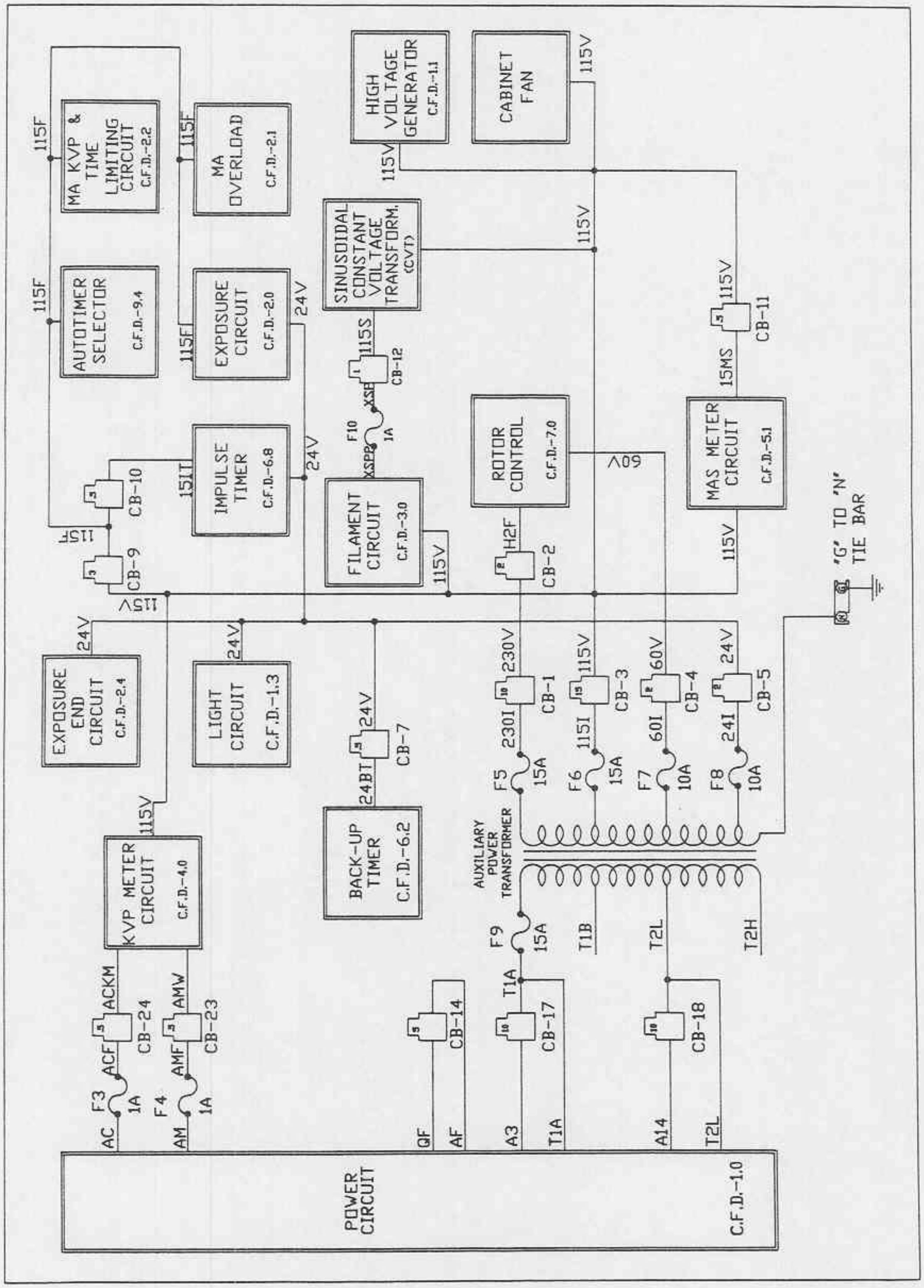

POWER CIRCUIT
C.F.D.-1.0
AC
AM
QF
AF
A3
T1A
A14
T2L
F3
1A
ACF
F4
AMF
ACKM
AMW
CB-24
CB-23
CB-14
CB-17
CB-18
KVP METER CIRCUIT
C.F.D.-4.0
115V
EXPOSURE END CIRCUIT
C.F.D.-2.4
24V
LIGHT CIRCUIT
C.F.D.-1.3
BACK-UP TIMER
C.F.D.-6.2
24BT
CB-7
F9
15A
T1A
T1B
T2L
T2H
AUXILIARY POWER TRANSFORMER
F5
15A
230I
230V
CB-1
F6
115I
115V
CB-3
F7
10A
60I
60V
CB-4
F8
24I
24V
CB-5
"G" TO "N" TIE BAR
CB-9
115F
CB-10
15IT
IMPULSE TIMER
C.F.D.-6.8
FILAMENT CIRCUIT
C.F.D.-3.0
XSPP
F10
XSF
CB-12
115S
ROTOR CONTROL
C.F.D.-7.0
H2F
CB-2
MAS METER CIRCUIT
C.F.D.-5.1
15MS
CB-11
AUTOTIMER SELECTOR
C.F.D.-9.4
EXPOSURE CIRCUIT
C.F.D.-2.0
SINUSOIDAL CONSTANT VOLTAGE TRANSFORM. (CVT)
MA KVP & TIME LIMITING CIRCUIT
C.F.D.-2.2
MA OVERLOAD
C.F.D.-2.1
HIGH VOLTAGE GENERATOR
C.F.D.-1.1
CABINET FAN

FIGURE 2-3 CFD 1.2

2.5 LIGHT CIRCUIT, CFD 1.3 (FIGURE 2-4)

The majority of lamps illuminate from 24 VAC. Exceptions are the lamp in the PREPARE push button which illuminates from 115 VAC, the Autotimer station lamps and the Autotimer safety indicator which operate from 6 V.

The mA select, Autotimer stations and Autotimer density push buttons are mechanically latching type switches. When one push button is selected, it is "latched" into position and the lamp in that push button illuminates. Also the previously depressed push button is released and its lamp extinguishes.

When the MAINS switch is depressed, the lamp inside the switch illuminates via 24 VAC to indicate that voltage is being supplied to the main control and that the Control is turned on.

The lamp inside the PREPARE push button will illuminate from the 115 VAC source after the PREPARE push button is depressed and the rotor delay time has passed. The illuminated lamp informs the operator that the rotor is "up-to-speed" and the control is ready to make an exposure. The 115 VAC for the lamp comes from the "OHO" lead in the Rotor Control PCB (CFD 7.0, FIGURE 2-22).

The lamp in the EXPOSE push button will illuminate only when the push button is depressed and an exposure actually takes place. The lamp will illuminate at the start of the exposure and extinguish at the end of the exposure. The 24 VAC for the lamp comes from the "BAL" lead in the Impulse Timer PCB (CFD 6.0, FIGURE 2-19).

The lamp in the SAFETY RESET push button will illuminate whenever an improper technique is entered into the control or when an overload was experienced during an exposure. The 24 VAC for the lamp comes from lead "ES" in the Exposure Interlock PCB (CFD 2.0, FIGURE 2-5).

The Light Circuit is protected by fuse F8 and circuit breakers CB5 and CB6 for the 24 VAC source and by fuse F6 and circuit breakers CB3 and CB9 for the 115 VAC source (CFD 1.1, FIGURE 2-2).

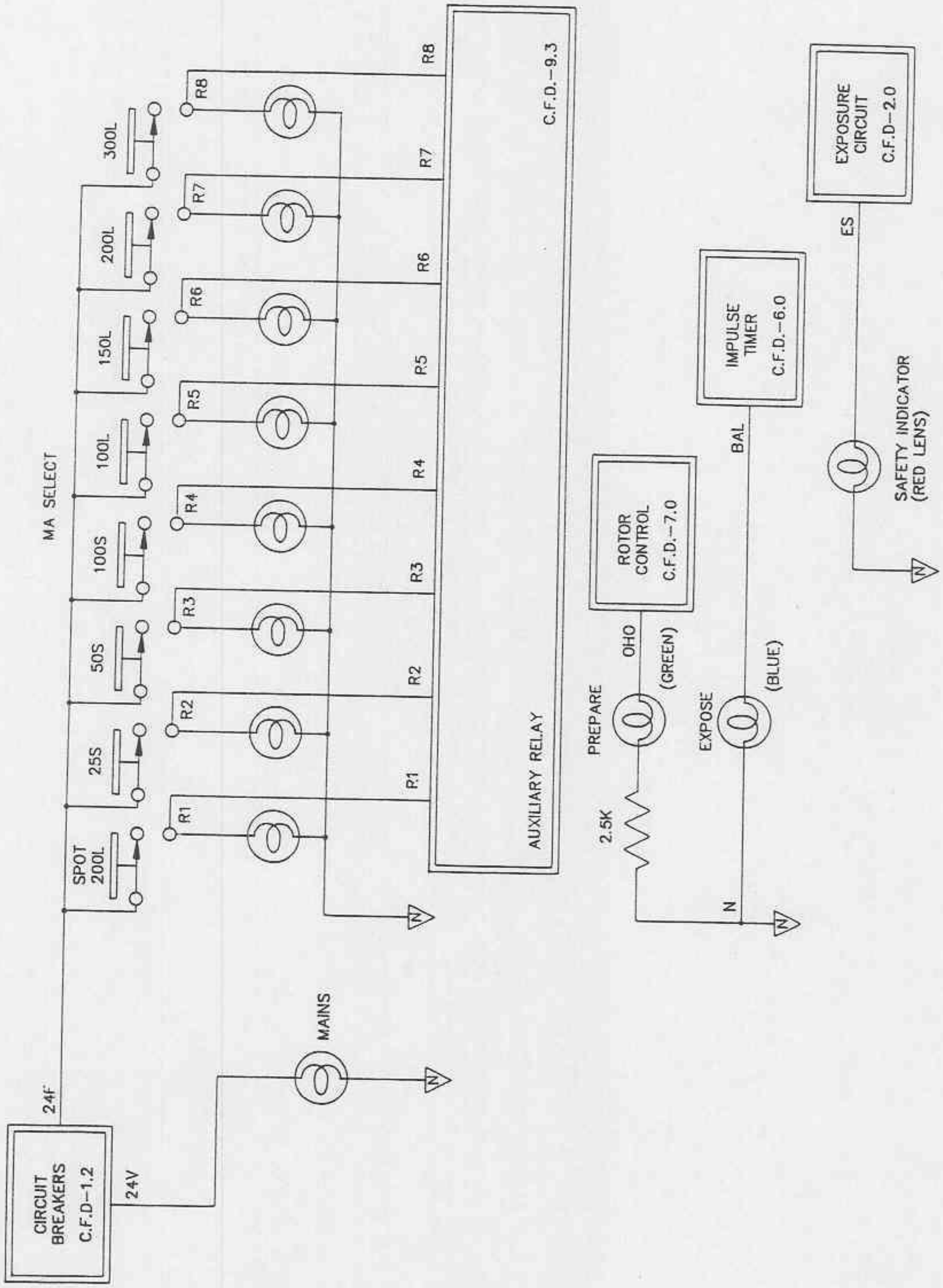

CIRCUIT BREAKERS C.F.D–1.2
24F
24V
MAINS
MA SELECT
SPOT 200L
25S
50S
100S
100L
150L
200L
300L
R1
R2
R3
R4
R5
R6
R7
R8
AUXILIARY RELAY
C.F.D.–9.3
2.5K
PREPARE
OHO
(GREEN)
ROTOR CONTROL C.F.D.–7.0
EXPOSE
(BLUE)
BAL
N
IMPULSE TIMER C.F.D.–6.0
ES
EXPOSURE CIRCUIT C.F.D–2.0
SAFETY INDICATOR (RED LENS)

FIGURE 2-4 CFD 1.3

2.6 EXPOSURE CIRCUIT, CFD 2.0 (FIGURE 2-5)

Before an exposure can be accomplished, the Interlock Safety Relay Re-2 on the Exposure Interlock PCB (FIGURE 2-6) must be energized and the SAFETY RESET lamp extinguished.

Relay Re-2 is energized whenever a satisfactory technique is entered into the Control by 115 VAC through lead ERE. With Re-2 energized, 24 V to ES is opened turning off the SAFETY RESET lamp. Also, BCE to B2 is closed, and OHO to BUC is closed.

During a normal radiographic exposure, the spot film mA select push buttons SPOT 200L is not depressed. This allows 115 VAC from 115F to be across a normally closed pole of RE1 of the Auxiliary Relay PCB (CFD 9.3, FIGURE 2-26) to lead CE and to one side of the PREPARE push button which is normally open.

When the PREPARE push button is depressed, 115 VAC is now on lead H3 to one side of the normally open EXPOSE push button, to the normally open contacts H3/FE of Re-3-SF in the Spot Film Changeover Circuit (CFD 8.1, FIGURE 2-23), to the coil of the Fluoro/Rad Changeover Contactor Re-21 (CFD 1.0, FIGURE 2-1) enabling it, preventing a fluoro exposure.

115 VAC is applied to the normally open contacts H3/OHO of Re-3 in the Rotor Control Circuit which will close when the x-ray tube anode attains normal speed, and to the coil of Re-3-BT on the Back-up Timer (CFD 6.2, FIGURE 2-20).

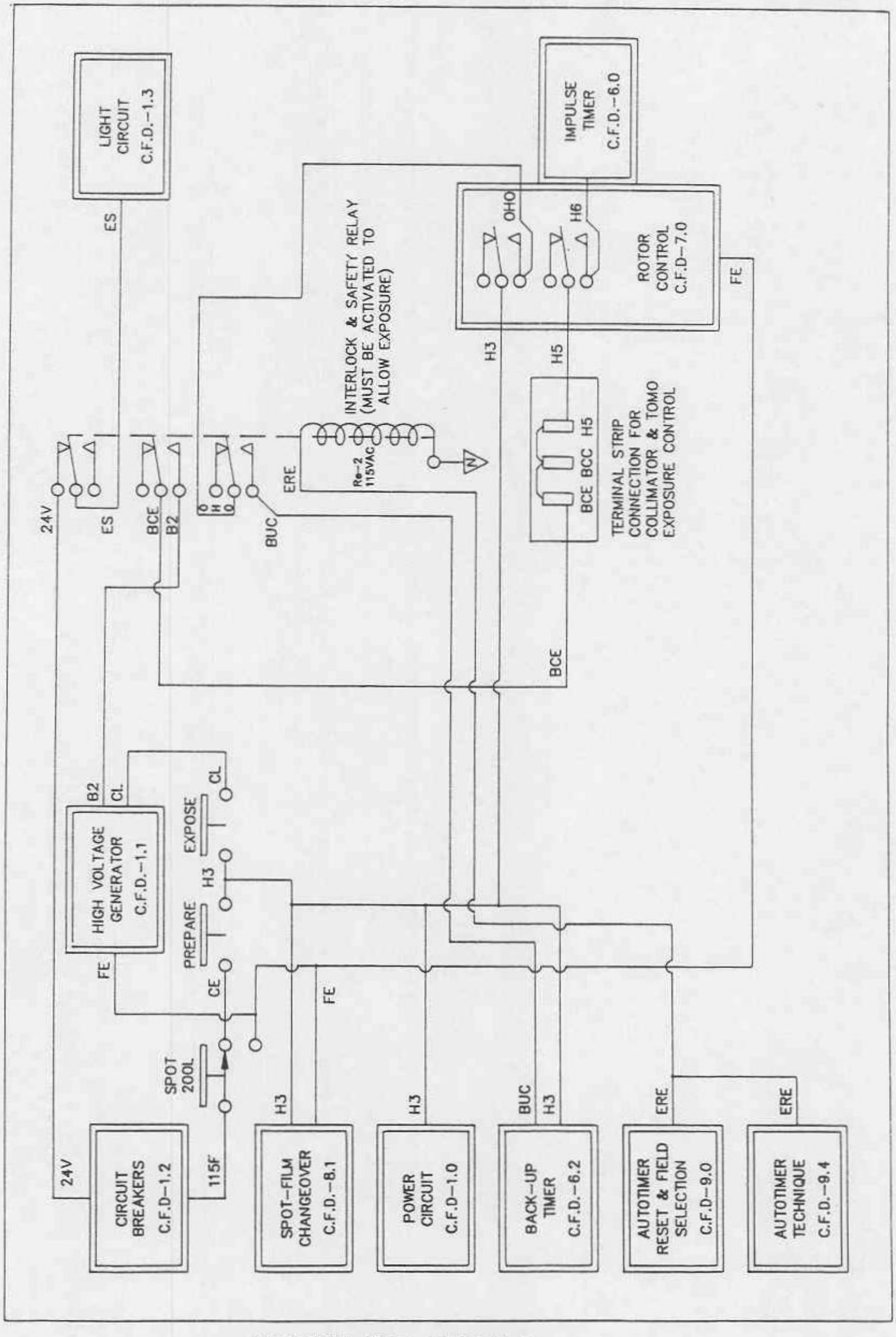
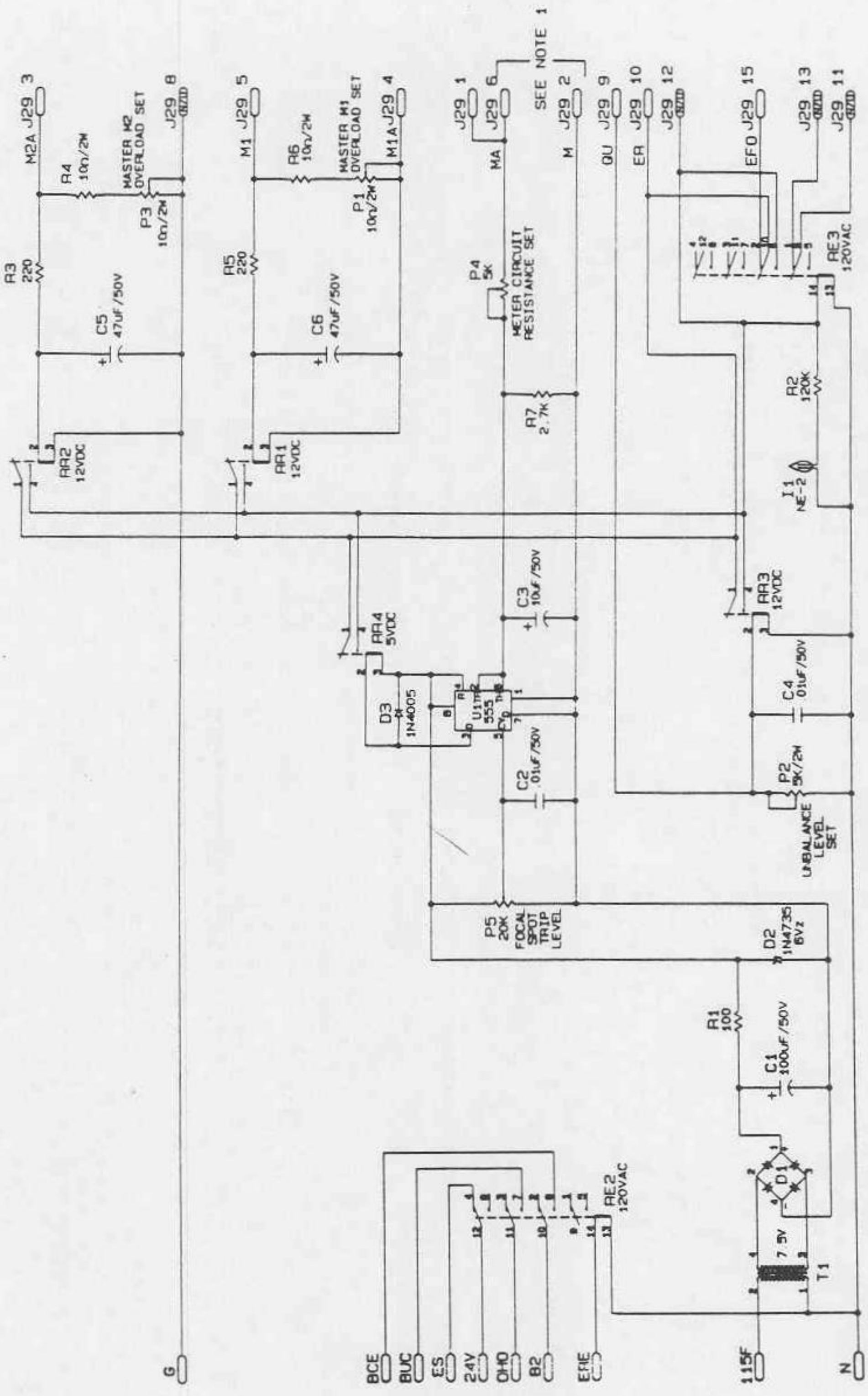

LIGHT CIRCUIT C.F.D.-1.3
IMPULSE TIMER C.F.D.-6.0
ROTOR CONTROL C.F.D-7.0
OHO
H6
H3
H5
FE
ES
INTERLOCK & SAFETY RELAY (MUST BE ACTIVATED TO ALLOW EXPOSURE)
Re-2 115VAC
ERE
24V
BCE
B2
OHO
BUC
TERMINAL STRIP CONNECTION FOR COLLIMATOR & TOMO EXPOSURE CONTROL
BCE BCC H5
BCE
HIGH VOLTAGE GENERATOR C.F.D.-1.1
B2
CL
FE
PREPARE
H3
EXPOSE
CL
CE
SPOT 200L
115F
FE
CIRCUIT BREAKERS C.F.D-1.2
24V
SPOT-FILM CHANGEOVER C.F.D.-8.1
H3
POWER CIRCUIT C.F.D-1.0
H3
BACK-UP TIMER C.F.D.-6.2
BUC
H3
AUTOTIMER RESET & FIELD SELECTION C.F.D-9.0
ERE
AUTOTIMER TECHNIQUE C.F.D.-9.4
ERE

FIGURE 2-5 CFD 2.0


M2A J29 3
R4 10Ω/2W
MASTER M2 OVERLOAD SET
J29 8
P3 10Ω/2W
R3 220
C5 47uF/50V
RR2 12VDC
M1 J29 5
R6 10Ω/2W
MASTER M1 OVERLOAD SET
M1A J29 4
P1 10Ω/2W
R5 220
C6 47uF/50V
RR1 12VDC
RR4 5VDC
D3 1N4005
U1 555
C2 .01uF/50V
C3 10uF/50V
J29 1
MA J29 6
SEE NOTE 1
M J29 2
P4 5K
METER CIRCUIT RESISTANCE SET
R7 2.7K
P5 20K
FOCAL SPOT TRIP LEVEL
QU J29 9
ER J29 10
J29 12
EFO J29 15
J29 13
J29 11
RE3 120VAC
R2 120K
I1 NE-2
RR3 12VDC
C4 .01uF/50V
P2 5K/2W
UNBALANCE LEVEL SET
D2 1N4735 6Vz
R1 100
C1 100uF/50V
D1
T1
7.5V
RE2 120VAC
G
BCE
BUC
ES
24V
OHO
B2
ERE
115F
N

NOTES:
1. ADJUST P4 SO THAT THE RESISTANCE ACROSS J29-2 AND J29-6 IS 5.00K OHMS
2. ALL RESISTORS 1/2W UNLESS OTHERWISE SPECIFIED
3. FOR ASSEMBLY DRAWING SEE 6284.234.04

FIGURE 2-6 EXPOSURE INTERLOCK PCB

2.6 EXPOSURE CIRCUIT, CFD 2.0 (continued)

The normally closed contacts XD/XBR open which removes the standby filament voltage from the x-ray tube and applies the boost voltage to the selected filament.

After the time delay as determined by the adjustment of P1 on the Rotor Control PCB (CFD 7.0, FIGURE 2-22), relay Re-3 on the same board energizes closing normally open contacts H3/OHO and H5/H6. Relay contacts H3/OHO allow 115 VAC to illuminate the lamp in the PREPARE push button and pass across normally open, now closed, contacts OHO/BUC of Re-2 Interlock & Safety relay to energize the Back-up Contactor.

The control is now ready to initiate the expose sequence.

The expose sequence is started by depressing the EXPOSE push button. This allows 115 VAC to be across the normally open, now closed, push button switch to the normally closed contacts CL/B2 of the tube select relay.

115 VAC will be:

- across the normally open, now closed, contacts B2/BCE of the Interlock & Safety relay Re-2;
- to the terminal strip connections BCE/BCC/H5 for the collimator exposure control;
- across normally open, now closed, contacts H5/H6 of relay Re-3 on the Rotor Control PCB;
- to the Impulse Timer PCB to start the timer operations.

During the exposure, 24 VAC on lead BAL from the Impulse Timer PCB (CFD 6.0, FIGURE 2-19) illuminates the lamp inside the EXPOSE push button during the duration of the exposure only.

When a spot film technique is used, SPOT 200L is depressed. Re-1 is energized inhibiting the PREPARE and EXPOSE push buttons, and applying 115 VAC to lead FE. Lead FE now takes control of the system and changes the control functions from a radiograph using the over-table tube to a radiograph using the under-table tube.

2.7 MA OVERLOAD CIRCUIT, CFD 2.1 (FIGURE 2-7)

The MXR-350 Generator has four (4) separate sensing circuits that are active during an exposure sequence and which are sensing for excessive loading of the high voltage components. These sensing circuits sample the Positive (+) mA and Negative (-) mA Overloads, Unbalance and Focal Spot Overload.

When an excessive current is sensed a relay is activated connecting leads ER/E2 of the Re-3-EI. This action enables Re-3 on Exposure Interlock PCB (FIGURE 2-6) opening ER/EFO and releasing Re-2 (CFD 2.0 FIGURE 2-5) which illuminates the SAFETY RESET lamp on the main control front panel push buttons and opens the B2/BCE Exposure Continuity Circuit.

Relay RR-1 positive (+) mA Overload is activated whenever the current in the anode circuit of the x-ray tube exceeds 360 mA. This current is sensed from M1 across R5 and adjusted by P1.

When RR1 enables, its normally open contacts close putting ER to E2 and causing Re-3 to enable with the events taking place as previously described.

Relay RR-2 negative (-) mA Overload is activated in the same manner as relay RR-1 with the exception that it is sensed from M2A, across R3 and adjusted by P3. It enables whenever the current in the cathode circuit of the x-ray tube exceeds 360 mA with the same events and results as RR-1.

Relay RR-3 is the Unbalance relay and senses an unequal current amplitude in the parallel primaries of the high tension transformer. Whenever an unbalance occurs in the primary current, a voltage is induced in the unbalance monitor located in the high voltage generator (CFD 1.1 FIGURE 2-2).

This voltage is adjusted by P2 to represent about 3mA of unbalance current. When the voltage exceeds this threshold RR-3 enables and its normally open contacts close ER/E2 with the same events and results as previously described.

The Focal Spot Overload Relay RR-4 energizes when the current through P4 and R7 reaches 1.25 mA. The total resistance of R7 and P4 is 6000 Ω as adjusted by P4. Transformer (part number 4186.113.01) supplies 7.5 VAC which is rectified, filtered, and zenered to 6 VDC and produces a threshold voltage representing 1.25 mA for the 555 chip which is used as a comparator.

Whenever the current through R7 and P4 exceeds 1.0 mA by 25%, the 555 chip will trigger allowing RR-4 to energize closing ER/E2 with the same events and result as previously described.

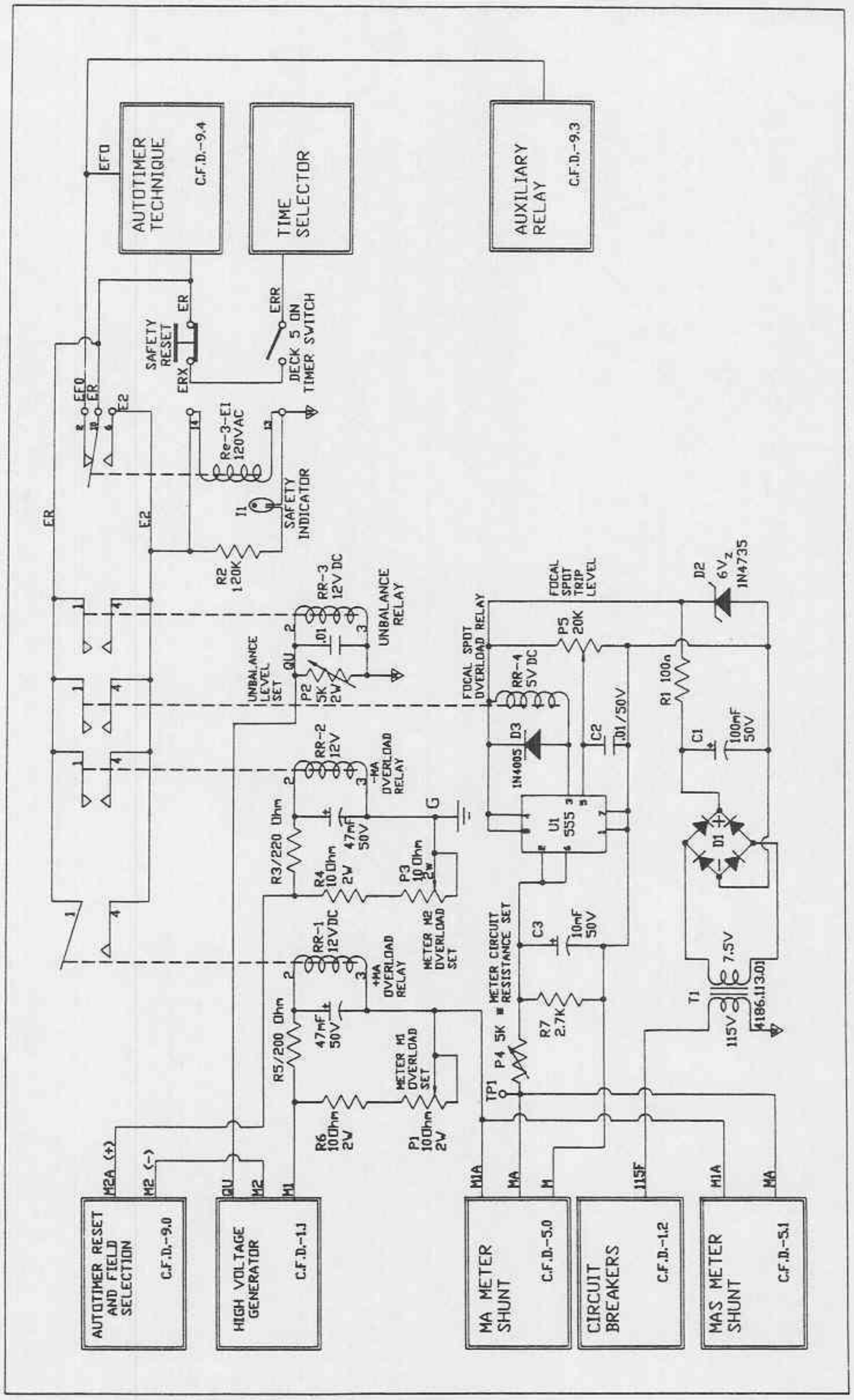

AUTOTIMER TECHNIQUE C.F.D.-9.4
TIME SELECTOR
AUXILIARY RELAY C.F.D.-9.3
EFO
SAFETY RESET
ER
ERX
ERR
DECK 5 ON TIMER SWITCH
EFO
ER
E2
Re-3-E1 120VAC
I4
I3
I1
SAFETY INDICATOR
ER
E2
R2 120K
RR-3 12V DC
UNBALANCE RELAY
UNBALANCE LEVEL SET
QU
P2 5K 2W
.01
FOCAL SPOT OVERLOAD RELAY
RR-4 5V DC
P5 20K
FOCAL SPOT TRIP LEVEL
D2 6Vz 1N4735
R1 100Ω
C1 100mF 50V
D3 1N4005
C2 .01/50V
RR-2 12V
-MA OVERLOAD RELAY
G
U1 555
D1
R3/220 Ohm
R4 10 Ohm 2W
47mF 50V
P3 10 Ohm 2W
METER M2 OVERLOAD SET
RR-1 12VDC
+MA OVERLOAD RELAY
C3 10mF 50V
METER CIRCUIT RESISTANCE SET
R7 2.7K
P4 5K
TP1
T1
7.5V
115V
4186.113.01
R5/200 Ohm
47mF 50V
METER M1 OVERLOAD SET
R6 10 Ohm 2W
P1 10 Ohm 2W
M2A (+)
M2 (-)
QU
M2
M1
M1A
MA
M
115F
M1A
MA
AUTOTIMER RESET AND FIELD SELECTION C.F.D.-9.0
HIGH VOLTAGE GENERATOR C.F.D.-1.1
MA METER SHUNT C.F.D.-5.0
CIRCUIT BREAKERS C.F.D.-1.2
MAS METER SHUNT C.F.D.-5.1

FIGURE 2-7 CFD 2.1

2.7 MA OVERLOAD CIRCUIT, CFD 2.1 (continued)

Resetting the SAFETY RESET is accomplished by depressing the SAFETY RESET push button on the control front panel. Doing this opens leads ERX/ER and removes the 115 VAC across the self holding contacts ER/E2 of Re-3 on Exposure Interlock PCB (FIGURE 2-6) which now de-energizes, extinguishing the lamp in the SAFETY RESET push button, if reset of the SAFETY RESET will allow another exposure to be taken.

If the overload condition still exists, the SAFETY RESET will again energize warning the operator of a consistent overload condition.

The time selector on the MXR-350 has a continuously rotatable detente switch which has three (3) open positions between the 1/120 and 8 second positions. When any of these three (3) positions are selected, deck eight (8) of the selector provides an opening to occur in lead ERX, which de-energizes its Re-2 on Exposure Interlock PCB (FIGURE 2-6), illuminates the lamp in the SAFETY RESET push button switch.

This indicates to the operator that an improper technique has been programmed into the generator. Depressing the SAFETY RESET push button switch will not reset the control and allow exposures to occur.

Only by rotating the time selector to an acceptable time station will the control be reset and permit exposures to take place.

2.8 MA, TIME, & KVP OVERLOAD (TOLA) CIRCUIT, CFD 2.2 (FIGURE 2-8)

The purpose of this assembly is to compare the selected time, the selected kVp, and the selected mA station, with preset references, depending on the type of x-ray tube used, and to either allow or disallow an exposure. The exposure would be permitted only if the selected technique would not overload the x-ray tube or system and cause an unsafe condition.

The power supply for the system is derived through a small isolation transformer T1, rectified, filtered and regulated at positive (+) 12 VDC and negative (-) 12 VDC relative to a 0 V, TP0.

Entering the PCB between leads MRY and MV, is a DC voltage linearly proportional to the selected kVp. Potentiometer P9 is used to adjust the range of change of this voltage for kVp values from 0 to 150 kVp. This adjusted voltage value is buffered by U1, whose output at pin 7 is a linear function of the selected kVp, and is known as the kVp analog.

Potentiometer P10 is the maximum kVp limit set. It is adjusted that the output of Pin 1 of U1 is at positive (+) 12 VDC whenever the kVp analog voltage is less than or equal to the 150 kVp value and falls to negative (-) 12 VDC when the kVp analog voltage is greater than the maximum kVp set. In the last case there will be no base drive for transistor Q1 and relay Re-1 will de-energize.

The time selection portion consists of a string of resistors sequentially connected between the poles of a timer switch deck.

The output, the common of the switch deck is a fixed proportion for each time selection of the voltage difference across the resistor string.

Input voltage KWH is connected at the shortest time end of the string, and KWL is connected at the longest time end of the string.

The time deck end point voltages, KWH and KWL, are adjusted independently for each mA station by the appropriate potentiometer (P1 - P8) for KWH value and by the appropriate potentiometer (P11 - P18) for the KWL value.

These adjustments set the voltage difference across the time select deck. The voltage value at TOL, an analog of the maximum allowed kVp, is the sum of the proportion of the voltage difference across the time selection deck plus the voltage value at KWL.

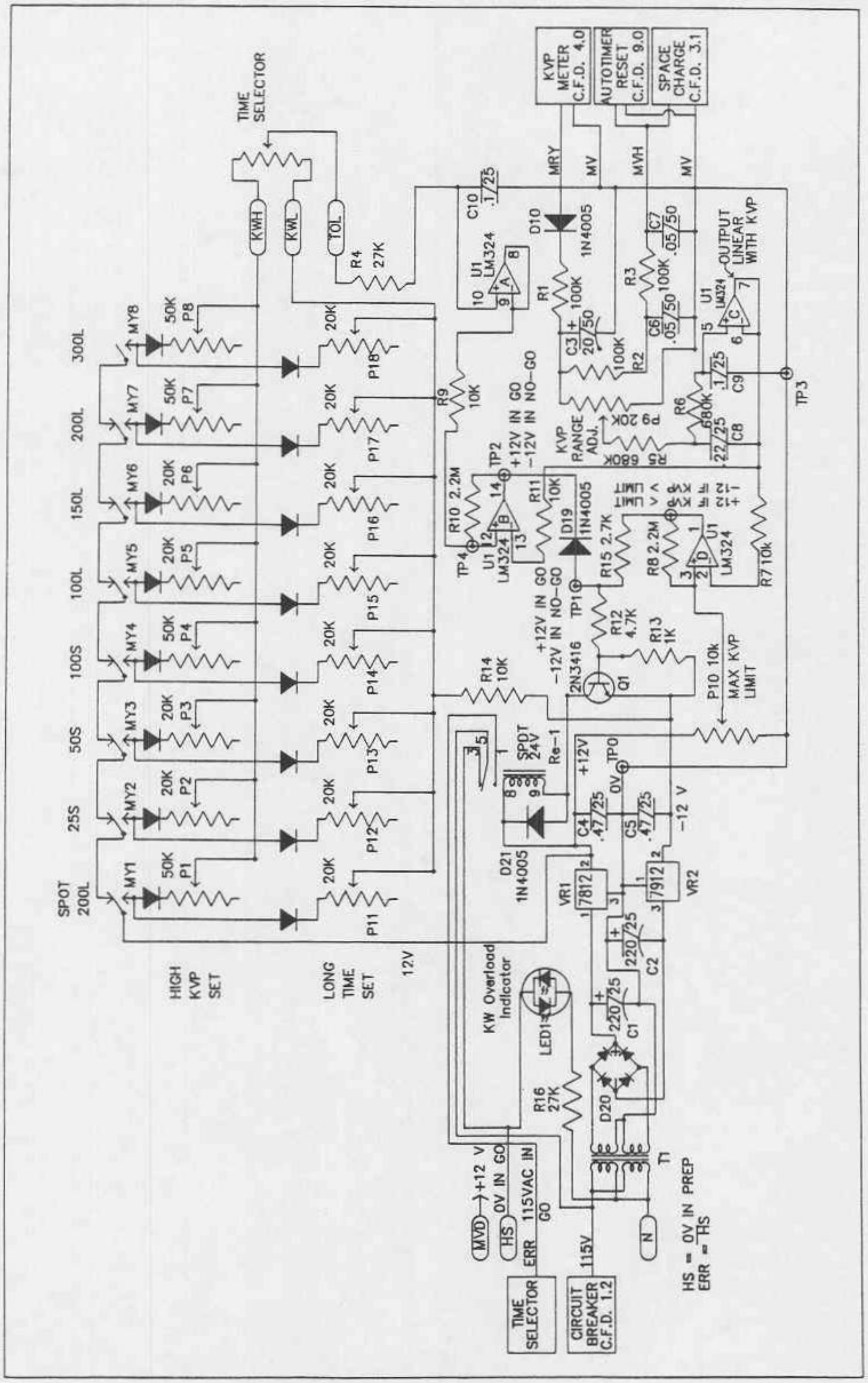

TIME SELECTOR
KWH
KWL
TOL
R4 27K
KVP METER C.F.D. 4.0
AUTOTIMER RESET C.F.D. 9.0
SPACE CHARGE C.F.D. 3.1
MRY
MV
MVH
MV
C10 .1/25
U1 LM324 A
D10 1N4005
R1 100K
C3 20/50
R3 100K
C7 .05/50
C6 .05/50
R2 100K
OUTPUT LINEAR WITH KVP
U1 LM324 C
R6 680K
C9 .1/25
C8 22/25
TP3
R9 10K
+12V IN GO −12V IN NO-GO
KVP RANGE ADJ.
P9 20K
R5 680K
TP2
R10 2.2M
U1 LM324 B
TP4
R11 10K
D19 1N4005
R15 2.7K
R8 2.2M
U1 LM324 D
R7 10k
TP1
+12V IN GO −12V IN NO-GO
R12 4.7K
R13 1K
P10 10k MAX KVP LIMIT
R14 10K
2N3416 Q1
SPDT 24V Re-1
+12V
TP0
0V
−12 V
C4 .47/25
C5 .47/25
D21 1N4005
VR1 7812
VR2 7912
C2 220/25
C1 220/25
KW Overload Indicator
LED1
R16 27K
D20
T1
SPOT 200L
25S
50S
100S
100L
150L
200L
300L
MY1
MY2
MY3
MY4
MY5
MY6
MY7
MY8
P1 50K
P2 20K
P3 20K
P4 50K
P5 20K
P6 20K
P7 50K
P8 50K
P11 20K
P12 20K
P13 20K
P14 20K
P15 20K
P16 20K
P17 20K
P18 20K
HIGH KVP SET
LONG TIME SET
12V
MVD +12 V
HS 0V IN GO
ERR 115VAC IN GO
115V
N
TIME SELECTOR
CIRCUIT BREAKER C.F.D. 1.2
HS = 0V IN PREP
ERR = HS

FIGURE 2-8 CFD 2.2

2.8 MA, TIME, & KVP OVERLOAD (TOLA) CIRCUIT, CFD 2.2 (continued)

The kVp analog voltage is applied to Pin 13 of U1. The TOL voltage, kVp maximum, is applied through a buffer to Pin 12 of U1. If the kVp analog is less than the kVp maximum, Pin 14 of U1 is at positive (+) 12 VDC. Transistor Q1, driven from Pin 1, U1 is on when the kVp is less than or equal to 150 kVp, and energizes relay Re-1. With Re-1 on, lead ERR of the Exposure Safety Circuit is at 115 VAC.

When the kVp analog exceeds the kVp maximum voltage, Pin 14 of U1 will go low to negative (-) 12 VDC. This will remove the base drive voltage of Q1 and turn Q1 off. Relay Re-1 opens the 115 V to ERR continuity, which will inhibit the Exposure Circuit. LED1 now lights through the normally closed pole of Re-1 to indicate that the assembly is in a "no-go" condition.

2.9 EXPOSURE END SIGNAL, CFD 2.4 (FIGURE 2-9)

24 VAC enters the PCB at 24F where it is rectified, filtered, zenered to positive (+) 10 VDC, and is applied to the U1 NAND gate and the collector of the Q1 transistor. Since no exposure is being made, the Q1 and Q2 transistors are biased off and do not conduct. No current flows through the DC Buzzer and it is silent.

During exposure, BAS is high causing the Q1 transistor to conduct and its collector goes low. This puts lows on pins 1 and 2 of the U1 which produces a high at pin 3 and allows the capacitor C1 charge via the diode D1. The capacitor C1 charges (about 1.5 msec for full charge) do not affect the output at pin 4 which remains high.

Pins 12 and 13 of U1 remain high so, during exposure, pin 11 remains low, holding the transistor Q2 off, with no conduction taking place and the DC Buzzer L1 remains silent during exposure.

When the exposure ends, BAS returns low turning off the 2N3416 transistor and its collector goes high putting highs on pins 1, 2 and 5 of the U1. Pin 3 of the U1 goes low and allows the .47 mFd capacitor to discharge through the 220 KΩ resistor R5 and the 1 MΩ potentiometer P1.

The discharge time is adjustable by P1 to between 0.1 second and 0.5 second. During the capacitor C1 discharge, pin 5 of the U1 will be at a logic high causing pin 4 to become low. Pin 13 of the U1 is high, pin 12 is low during the capacitor discharge, pin 11 is high, during the capacitor discharge, to the base of the Q2 transistor, turning it on and allowing conduction to take place during the capacitor discharge time. The DC Buzzer is activated and it sounds during the capacitor discharge time after the exposure has been terminated.

After the discharge time as determined by P1 has elapsed, pins 6 and 11 of the U1 return low, turning off the transistor Q2, and the DC Buzzer L1 is silenced.

There are two (2) adjustments for the Exposure End Signal. They are P1 which adjusts the duration of the signal, and P2 which adjusts the loudness of the signal.

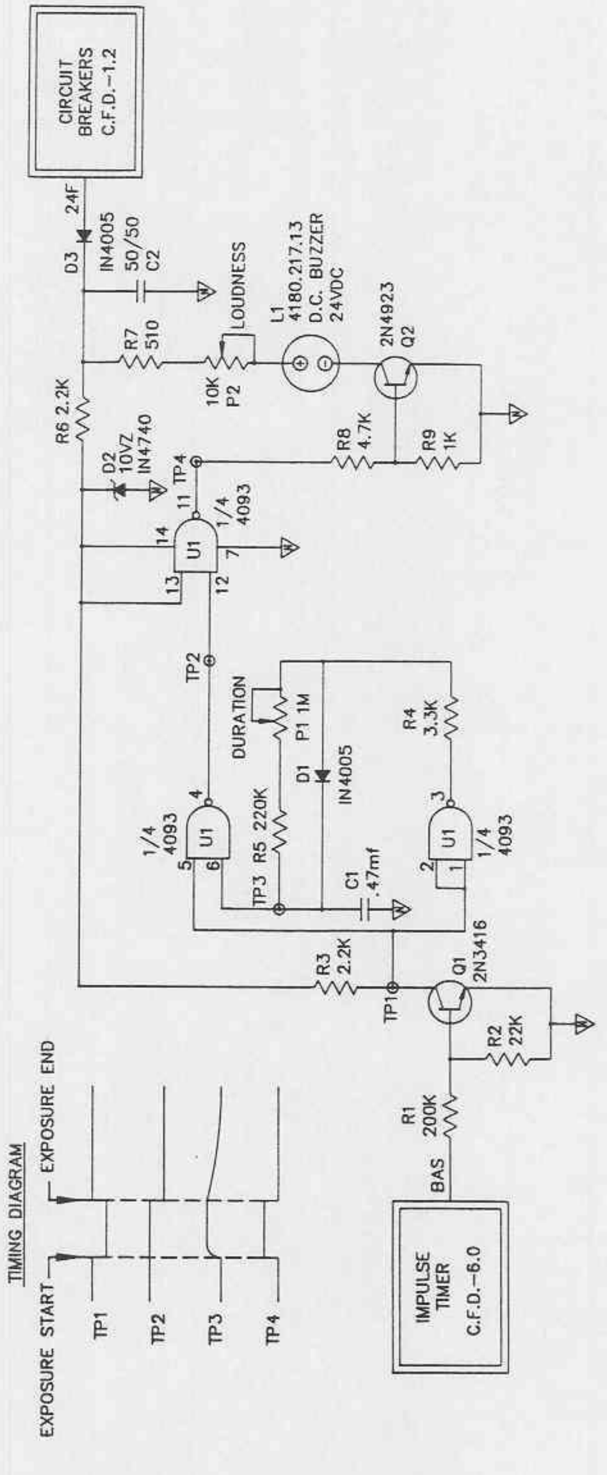

CIRCUIT BREAKERS C.F.D.-1.2
24F
D3
IN4005
50/50
C2
R7
510
LOUDNESS
10K
P2
L1
4180.217.13
D.C. BUZZER
24VDC
2N4923
Q2
R6 2.2K
D2
10VZ
IN4740
TP4
11
14
U1
1/4
4093
7
13
12
R8
4.7K
R9
1K
TP2
DURATION
P1 1M
D1
IN4005
R4
3.3K
4
1/4
4093
U1
5
6
R5 220K
3
2
1
U1
1/4
4093
TP3
C1
.47mf
R3
2.2K
Q1
2N3416
TP1
R2
22K
R1
200K
BAS
IMPULSE TIMER C.F.D.-6.0
TIMING DIAGRAM
EXPOSURE START
EXPOSURE END
TP1
TP2
TP3
TP4

FIGURE 2-9 CFD 2.4

2.10 EXPOSURE AND AUTOTIMER SAFETY CIRCUIT, CFD 2.6 (FIGURE 2-10)

From circuit breaker CB3, 115 VAC goes to the common of the relay contact set of Re-1-MTK on mA, Time and kVp Overload Circuit (CFD 2.2).

Relay Re-1-MTK is energized when a valid or allowable technique has been selected. Across normally open, now closed contact of Re-1-MTK is 115 VAC to ERR. ERR connects to the common of a deck on the Timer Switch assembly.

When a valid time has been selected, continuity is to ERX, then across the normally closed SAFETY RESET switch to ER.

From the SAFETY RESET switch, ER continues to the normally closed contact of Re-3-EI, on mA Overload Circuit (CFD 2.1), to EFO. Signal EFO branches to the common contacts of Re-1-AT on Autotimer Technique Circuit (CFD 9.4, FIGURE 2-27) and to a common contact of Re-2-AU on Auxiliary Circuit PCB (CFD 9.3, FIGURE 2-26).

Circuit continuity now depends on whether the Autotimer is on or off. If the Autotimer is off, relay Re-1-AT is off, and EFO is across normally closed contact to ERE. ERE energizes relay Re-2-EI on Exposure Circuit (CFD 2.0). When Re-2-EI is energized, the SAFETY RESET Lamp is out and exposure signal continuity is closed between B2 and BCE.

When the autotimer is on, Re-1-AT energizes, and opens circuit continuity EFO/ERE. EFO is also a common contact of Re-2-AUX. If the spot film mA selection is on, EFO is normally across closed contacts of Re-2 to Re-8 to ERS. ERS continues to the Autotimer chamber and density select switch assembly. If the spot film Autotimer chamber has been selected, ERS is across normally open, now closed switch contact to ERE, and exposure is possible.

If the Autotimer TABLE chamber selector switch is on, ERE stays low, The SAFETY RESET lamp is lit and exposure is inhibited.

When autotiming is selected, the mA station selected must correspond to the ion chamber selected for exposure to be possible.

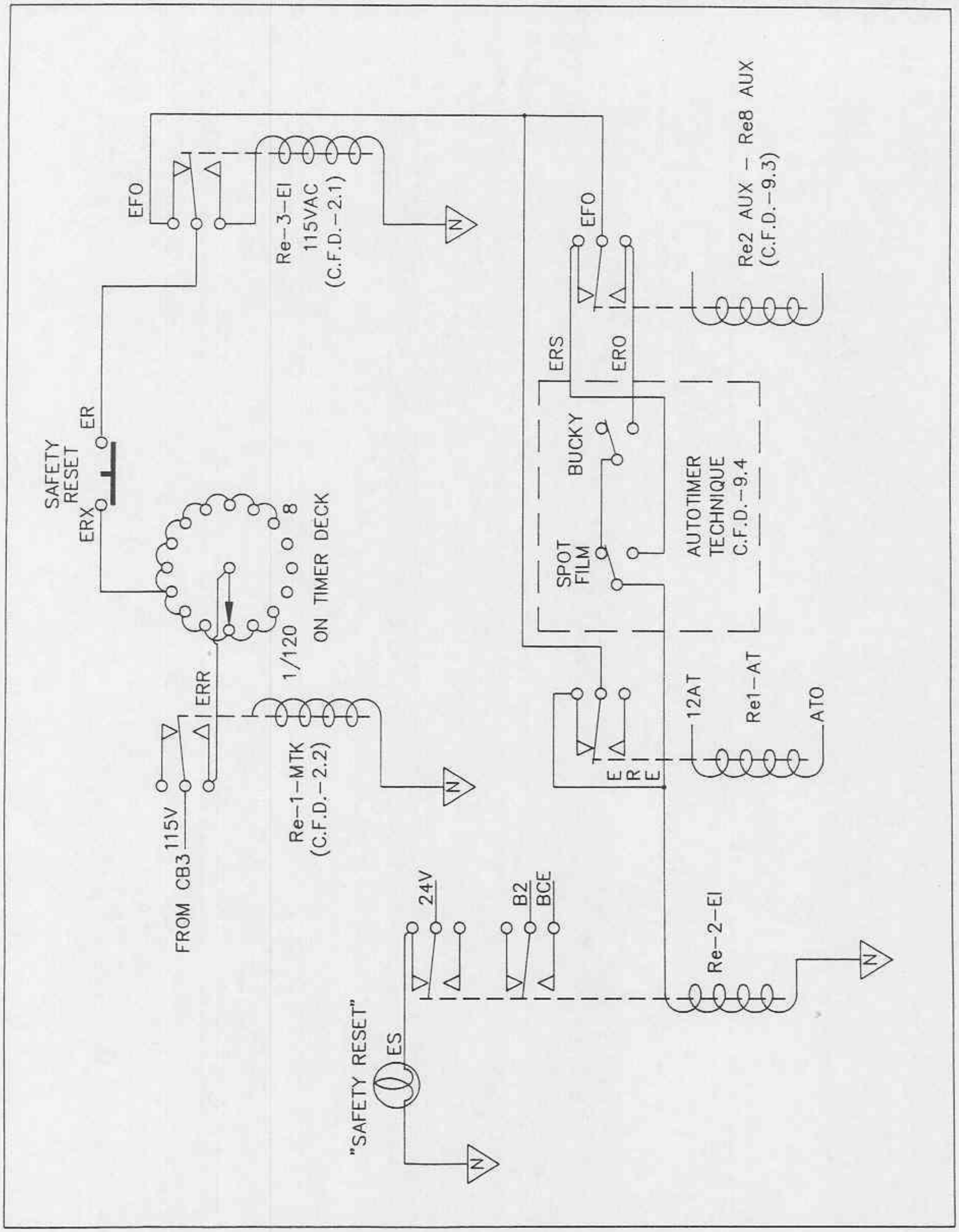

EFO
Re-3-EI
115VAC
(C.F.D.-2.1)
N
SAFETY
RESET
ER
ERX
8
ON TIMER DECK
1/120
ERR
FROM CB3
115V
Re-1-MTK
(C.F.D.-2.2)
N
24V
B2
BCE
"SAFETY RESET"
ES
N
Re-2-EI
N
EFO
Re2 AUX - Re8 AUX
(C.F.D.-9.3)
ERS
ERO
BUCKY
SPOT
FILM
AUTOTIMER
TECHNIQUE
C.F.D.-9.4
12AT
Re1-AT
ATO
E
R
E

FIGURE 2-10 CFD 2.6

2.11 FILAMENT CIRCUIT, CFD 3.0 (FIGURE 2-11)

The primary purpose of the Filament Circuit is to provide a constant current source for the filament transformers as determined by the selected mA and kVp.

From the Constant Voltage Transformer (CVT) on lead XSP through fuse F12 to XSPP (CFD 1.2) is 120 VAC to transformer (part number 5286.230.06) which is acting as an impedance transformer.

The voltage drop across this transformer varies as the amount of conduction of the MJ15001 transistor in the cooling chimney changes. The diode bridge on the secondary of the impedance transformer acts as a variable resistor load. When the MJ15001 transistor is off and not conducting, the diode bridge acts as an open circuit and the impedance in the primary winding is high.

When the MJ15001 transistor is conducting, the diode bridge acts a variable load resulting in a low impedance in the primary with the current being inversely proportional to the impedance.

From the Circuit Breakers (CFD 1.2) comes 115 VAC to the filament drive transformer primary. The secondary of this transformer produces 40 VAC, center tapped, to diode bridge BR-1 where it is rectified, regulated to positive (+) 15 VDC by 7815 regulator and to negative (-) 15VDC by regulator 7915.

The unregulated positive and regulated DC voltage is also used to supply the power to the amplifying transistors for the cooling chimney driving circuit.

A feedback transformer is used to provide a current feedback source to sample the amount of current in the filament transformer drive line. This feedback is rectified by BR-2 and is input into pins 5 and 6 of IC1. Pin 7 (TP10) of IC1 will be a positive DC voltage which is representative of the amount of current feedback.

On lead XDA (TP11) from the Filament Selection (CFD 3.2) is a voltage representing the mA station selected. This is the Filament Set and is input to IC1 at pin 3. Pin 1 of IC1 (TP9) will now output a negative DC voltage which will be representing the mA station selected.

On lead XCM from the Space Charge Circuit (CFD 3.1) will be a DC voltage representative of the Space Charge (TP12). This voltage will be negative voltage below 78 kVp and a positive voltage above 78 kVp. At 78 kVp that voltage will be zero (0) volts.

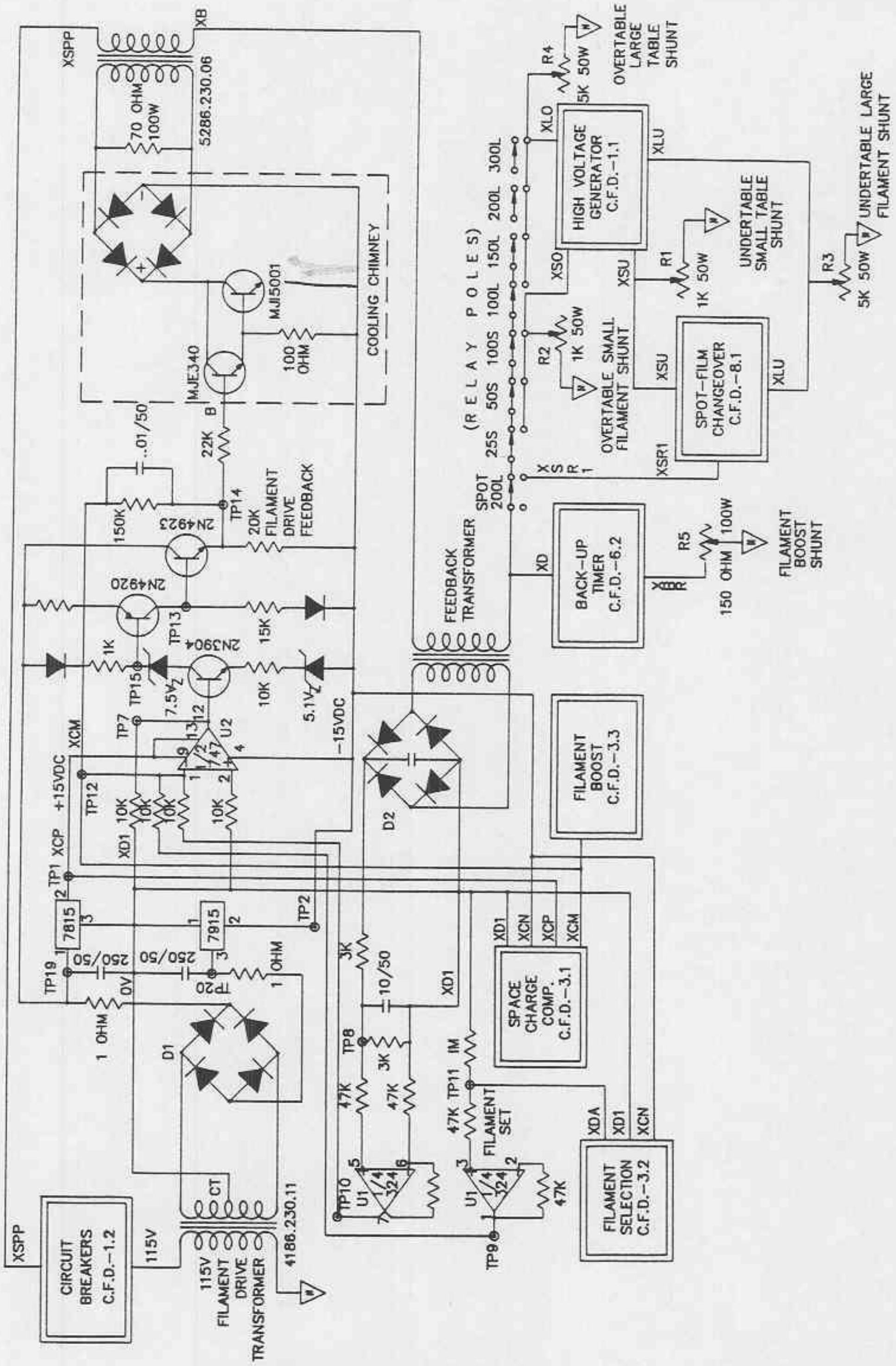

XSPP
XB
5286.230.06
70 OHM 100W
COOLING CHIMNEY
MJ15001
MJE340
100 OHM
B
.01/50
22K
150K
TP14
2N4923
20K FILAMENT DRIVE FEEDBACK
2N4920
1K
TP13
15K
2N3904
TP15
7.5V
10K
5.1V
TP7
12
13
U2
1/2 747
9
4
1
2
XCM
-15VDC
+15VDC
TP12
10K
10K
10K
10K
XD1
XCP
TP1
D2
FEEDBACK TRANSFORMER
7815
7815
TP2
TP19
250/50
250/50
0V
TP20
1 OHM
1 OHM
D1
3K
10/50
XD1
TP8
3K
47K
47K
TP10
U1 1/4 324
5
6
7
IM
47K TP11
FILAMENT SET
3
2
U1 1/4 324
47K
TP9
CT
4186.230.11
CIRCUIT BREAKERS C.F.D.-1.2
115V
115V FILAMENT DRIVE TRANSFORMER
SPACE CHARGE COMP. C.F.D.-3.1
XD1
XCN
XCP
XCM
FILAMENT SELECTION C.F.D.-3.2
XDA
XD1
XCN
FILAMENT BOOST C.F.D.-3.3
BACK-UP TIMER C.F.D.-6.2
XD
XBR
R5
150 OHM 100W
FILAMENT BOOST SHUNT
SPOT 200L
25S
50S
100S
100L
150L
200L
300L
(R E L A Y P O L E S)
XSR1
XSO
R2
1K 50W
OVERTABLE SMALL FILAMENT SHUNT
SPOT-FILM CHANGEOVER C.F.D.-8.1
XSU
XLU
HIGH VOLTAGE GENERATOR C.F.D.-1.1
XLO
XSU
XLU
R4
5K 50W
OVERTABLE LARGE TABLE SHUNT
R1
1K 50W
UNDERTABLE SMALL TABLE SHUNT
R3
5K 50W
UNDERTABLE LARGE FILAMENT SHUNT

FIGURE 2-11 CFD 3.0

2.11 FILAMENT CIRCUIT, CFD 3.0 (continued)

At TP14 is the Filament Drive Feedback voltage which is a sample of the Filament Drive voltage. It is this voltage that determines the amount of conduction of the cooling chimney transistors and ultimately the amount of impedance of the (part number 5286.230.06) transformer primary.

From leads XLO, XSO, XLU, and XSU are four (4) shunting resistors which are adjustable to provide sufficient current for the focal spots throughout the mA selectable range. These resistors do this by shunting excessive current to neutral.

From the Back-up Timer (CFD 6.2, FIGURE 2-20) comes lead XBR which is active during standby only. Filament current during standby is limited by an adjustable resistor R5 called the Standby Filament Current Sink. This resistor shunts excess filament current to neutral during standby to insure that the filaments are illuminated at a low level which provides longer x-ray tube life with the convenience of preheated filaments.

Into pin 1 of IC2 is summed the positive Filament Drive Feedback voltage, the positive or negative Space Charge voltage, the positive Current Feedback voltage, and the negative Filament Set voltage.

The output of IC2 at pin 12 (TP7) will be a positive voltage which will vary according to the mA and kVp selected. This voltage is amplified and becomes the filament drive voltage into the base of transistor MJE340 in the cooling chimney. This transistor causes the conduction of the MJ15001 transistor varying the conduction of the diode bridge, increasing or decreasing the impedance of the (part number 5286.230.06) transformer.

As the impedance increases in the transformer primary, as when a low mA station is selected, the current decreases and the voltage drop across the primary increases resulting in lower voltage to the filament transformer primaries. As the impedance decreases, such as when a high mA station is selected, the current increases and the voltage drop across the primary decreases resulting in a higher voltage to the filament transformer primaries.

A cooling fan is provided for the components in the cooling chimney to prevent overheating. These components are always in a conducting state even during standby.

The Filament Circuit is designed in such a manner that even if no filament drive was available, the x-ray tube filaments would not burn out because of over voltage.

2.12 SPACE CHARGE COMPENSATION, CFD 3.1 (FIGURE 2-12)

The reference point at which the Space Charge Compensation is zero (0) is at 78 kVp. This reference point is adjusted by P30 Set Point Adjust. This potentiometer is adjusted so that pin 10 of the 747 op-amp is at zero (0) volts (TP4) at 78 kVp.

On lead MVH is a DC voltage representative of the selected kVp which is input to IC9 at pin 2, the inverting input. The output of IC9 at pin 6 (TP17) will be a negative voltage proportional to the selected kVp and is input to the 747 op-amp at the inverting input, pin 7. The output of the 747 op-amp at pin 10 (TP4) will be a positive voltage above 78 kVp and a negative voltage below 78 kVp.

Assuming that 40 kVp has been selected, a low positive voltage is on lead MVH into pin 2 of IC9 resulting in a low negative voltage at pin 6. This low negative voltage being input to the 747 op-amp at pin 7 is less negative than the Set Point voltage at pin 6. The output at pin 10 will be a low negative voltage and Space Charge Compensation will be some portion of that low negative voltage as adjusted by pots P30.

By selecting a higher kVp, now assuming 78 kVp, at IC9 pin 2 becomes more positive driving pin 6 more negative. On pin 7 of the 747 op-amp, this more negative voltage equals the Set Point voltage on pin 6 and pin 10 becomes zero (0) volts. There will be no space charge compensation voltage.

As the selected kVp increases, now assuming 110 kVp, at IC9 pin 2 is at a higher positive voltage, pin 6 becomes even more negative. This more negative voltage comes to pin 7 of the 747 op-amp increasing the differential between pin 7 and the Set Point voltage at pin 6 causing the output at pin 10 to be proportionally positive. The space charge compensation will be a portion of that positive voltage as adjusted by potentiometer P30.

The Space Charge Compensation voltage goes to the Filament Circuit (CFD 3.0) via lead XCM to modify the filament drive voltage.

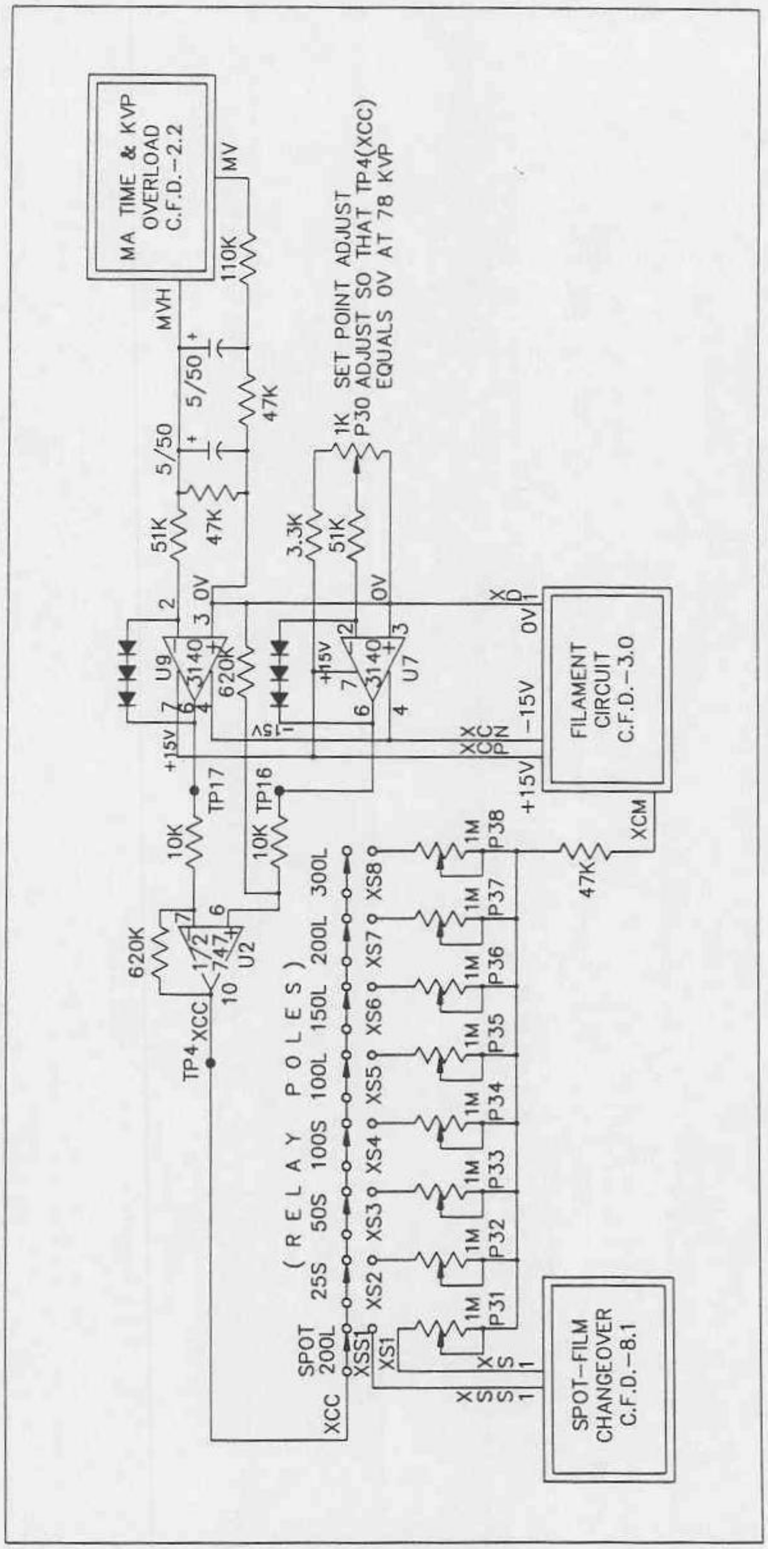

MA TIME & KVP
OVERLOAD
C.F.D.-2.2
MV
MVH
110K
5/50
5/50
47K
51K
47K
3.3K
51K
1K
P30
SET POINT ADJUST
ADJUST SO THAT TP4(XCC)
EQUALS 0V AT 78 KVP
0V
0V
620K
3140
U9
3140
U7
+15V
-15V
XD1
0V
XCC
XPN
FILAMENT
CIRCUIT
C.F.D.-3.0
TP17
TP16
10K
10K
620K
1/2
747
U2
TP4
XCC
XCM
47K
(RELAY POLES)
SPOT 200L
25S
50S
100S
100L
150L
200L
300L
XSS1
XS1
XS2
XS3
XS4
XS5
XS6
XS7
XS8
1M
P31
P32
P33
P34
P35
P36
P37
P38
XSS1
SPOT-FILM
CHANGEOVER
C.F.D.-8.1

FIGURE 2-12 CFD 3.1

2.13 FILAMENT SELECTION, CFD 3.2 (FIGURE 2-13)

On lead XCN is negative (-) 15 VDC which is regulated to negative (-) 8 VDC by the 7908 voltage regulator. This voltage is used to supply all parts of the Filament Selection Circuit and the final result on lead XDA mA Set will be some portion of that negative (-) 8 VDC.

Each mA selection is made by closing a set of normally open relay contacts which selects a series of potentiometers for the Coarse mA, Fine mA, and added filament boost adjustments. These potentiometers modify the negative (-) 8 VDC as necessary to produce the selected mA. Potentiometers P1 through P8 are the Coarse mA adjustments, P11 through P18 are the Fine mA adjustments, and P21 through P28 are the added filament boost adjustments for each mA station. Potentiometers P9, P19 and P29 are not used.

For discussion purposes assume the 100L mA selection has been made by depressing the 100L mA select push button. Normally open relay contacts XD1/XA5 are now closed and, because of the 100 KΩ pull-up resistor, a high comes to pin 1 of IC8.

IC8 is a 4532B 8 bit priority encoder. The output is the binary code for the respective input. If more than one (1) input is high simultaneously, the one (1) with the highest number will be encoded while the other input will be ignored.

In this discussion with the 100L mA station selected, pin 1, which is input 4, is high, the output of IC8 will be pin 6, which is the Q4 output, and it is a high to pin 9 of IC's 5 and 6.

IC's 5 and 6 are 4051B, 1 of 8 switches. The output is determined by the binary word input to channel or channels A SEL, B SEL, and C SEL. The input channel binary words are A SEL = 1, B SEL = 2 and C SEL = 4.

With the 100L mA station selected, the channel selected on IC's 5 and 6 is C SEL pin 9 which is a binary 4. The output is pin 1 (4) which is high and potentiometers P5 and P15 are selected as the mA adjust pots. They are connected to the output, pin 3.

Pin 3 of IC's 5 and 6 act as inputs or outputs. In the case of IC5 it is an input, and IC6 it is an output. Accordingly pin 3 of IC6 will output some portion of negative (-) 8 VDC as adjusted by P5 and P15 onto lead XDA which is the mA Set lead to the Filament Circuit. Internal to the chip is an FET switch from pin 1 to pin 3.

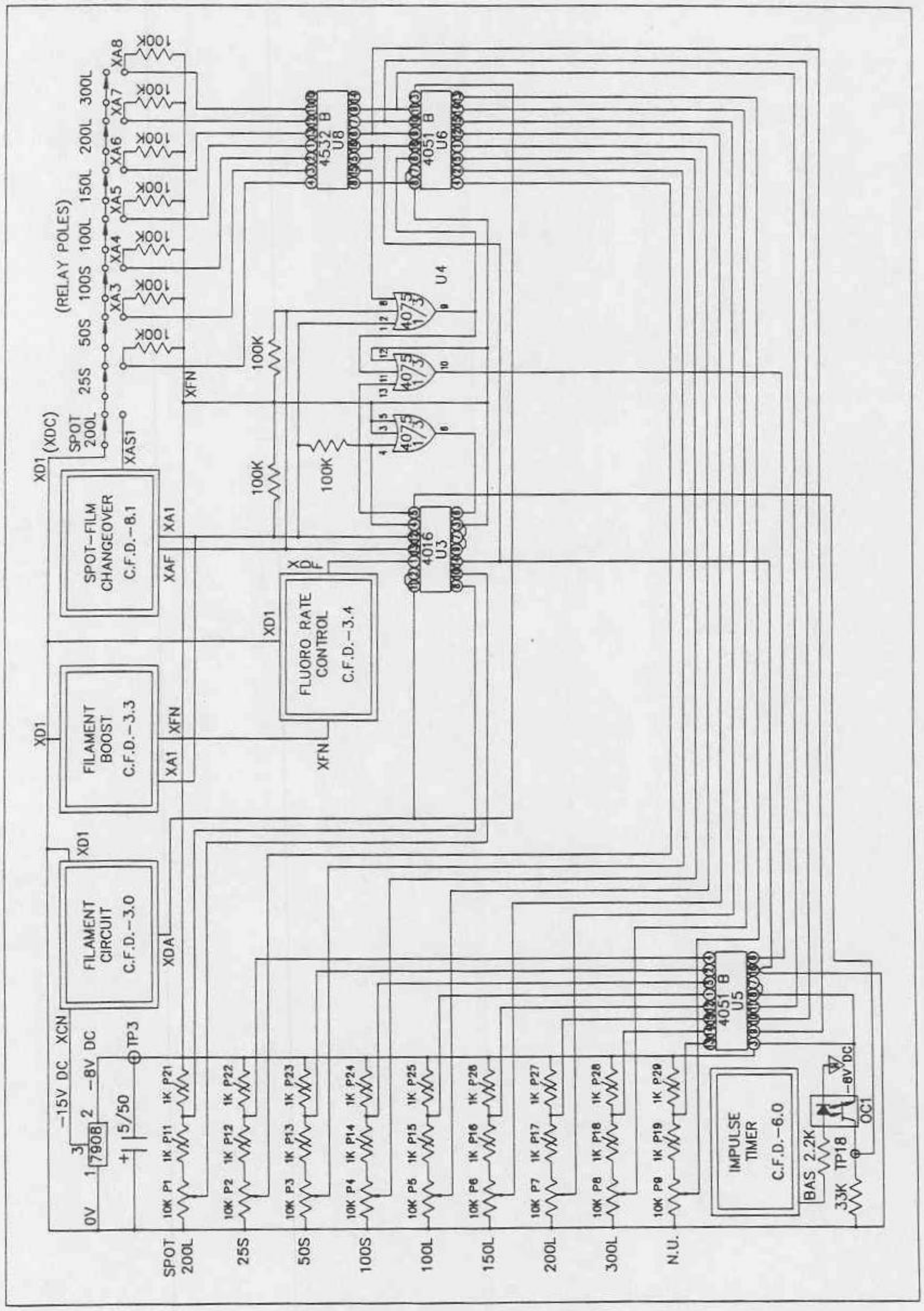

(RELAY POLES)
SPOT 200L
25S
50S
100S
100L
150L
200L
300L
XDC
XD1
XAS1
XA3
XA4
XA5
XA6
XA7
XA8
100K
XFN
4532 B
U8
4051 B
U6
4075
U4
4016
U3
SPOT-FILM CHANGEOVER C.F.D.-8.1
XA1
XAF
XDF
FLUORO RATE CONTROL C.F.D.-3.4
FILAMENT BOOST C.F.D.-3.3
FILAMENT CIRCUIT C.F.D.-3.0
XDA
XCN
-15V DC
-8V DC
TP3
7808
5/50
0V
10K P1
1K P11
1K P21
4051 B
U5
IMPULSE TIMER C.F.D.-6.0
BAS
2.2K
TP18
33K
OC1
-8V DC
N.U.

FIGURE 2-13 CFD 3.2

2.13 FILAMENT SELECTION, CFD 3.2 (continued)

Pin 3 of IC5 inputs negative (-) 8 VDC, which is output at pin 1 at the beginning of exposure, in effect shorting out P25, during the start of the exposure, giving the filament an added boost at the start of the exposure. This added boost insures that the full selected mA is across the tube from the first impulse of primary power through the last impulse. The negative (-) 8 VDC input to pin 3 of IC5 is supplied to pin 1 of IC5 via an internal FET switch in IC5.

Before an exposure is initiated, IC5 is inhibited due to OC1 optocoupler being turned off. Effectively a high is at TP18 to pin 13 of IC4 producing a high at pin 10 of IC4. This high goes to pin 6 of IC5 holding it off.

From the Impulse Timer (CFD 6.0, FIGURE 2-19), lead BAS is high throughout the actual length of exposure turning on OC1 optocoupler. This causes TP18 to be low, pins 13 and 10 of IC4 to be low lifting the inhibit from IC5, and shorts out P25 during exposure. When the exposure terminates, TP18 returns high inhibiting IC5. This sequence of events takes place whenever a radiographic exposure is initiated.

A spot film selection alters this sequence.

For purposes of discussion, assume the 200L SPOT, spot film selection has been made. When this spot film mA selected, a high exists on pin 13 of IC3 closing pins 1 to 2. This puts leads XDF Fluoro Adjust and XDA mA Set lead together.

Fluoro mA can now be adjusted via the Fluoro Rate Control (CFD 3.4, FIGURE 2-15). As long as the cassette tray remains in the out-of-beam position, the changeover switch will remain unchanged, pins 12 and 6 of IC3 will remain low so pins 10 to 11 and 8 to 9 will remain "open". Potentiometers P1, P11, P21 are not selected into the mA circuit.

When a spot film exposure is initiated, due to the cassette tray moving into the field, FE/RL are closed energizing relay Re-5-SF opening the normally closed contacts XAS1/XAF and closing the normally open contacts XAS1/XA1. Pin 13 of IC3 returns low, opening pins 1 to 2 and removing XDF Fluoro Adjust from XDA mA Set leads.

Lead XA1 to pin 12 of IC3 is a high which "closes" pins 10 to 11 connecting P1 and P11 to lead XDA mA Set. The Boost potentiometer P21 is into pins 8 to 9 of IC3 which are open because pin 6 is low.

At the start of exposure OC1 turns on, pins 5 and 6 of IC3 are high closing pins 9 to 8 and 11 to 10, Boost potentiometer P21 is shorted out, and ICs 5 and 6 are held inhibited. At the end of exposure, all return back to standby state.

2.14 FILAMENT BOOST CIRCUIT, CFD 3.3 (FIGURE 2-14)

This circuit provides a very fast method of boosting the x-ray tube filament temperature in preparation for a spot film exposure. This circuit is active only when a spot film mA station has been selected and boosts the filament during the time that the cassette tray is moving into the "in beam" position for exposure.

When a spot film mA selection is made, XA1 will be a high to analog switch U10. potentiometers P40 provides the amount of boost as selected by U10.

During standby lead RL from Spot Film Changeover (CFD 8.1, FIGURE 2-23) is at zero (0) volts and optocoupler U12 is turned off and its collector is high. Transistor Q1 is turned on and its collector is at negative (-) 8 VDC. On IC U10, pin 13 is high so pins 1 to 2 are "closed". Pin 5 is low so pins 3 to 4 are "open". The 20 Mfd capacitor is allowed to charge to negative (-) 8 VDC via U10.

When spot film PREP is initiated and the cassette tray leaves its parked position, lead RL becomes 115 VAC which is rectified by BR3 and turns on optocoupler U12 with its collector going low. This turns off transistor Q1 and its collector goes high. On U10, pin 13 is low so pins 1 to 2 are "open", interrupting the capacitor charge path, pin 5 is high so pins 3 to 4 are "closed" providing a discharge path for the capacitor through U10 and P40.

As the capacitor discharges, a voltage comes off of the wipers of P40 and is input to pin 12 of U1. U1 is acting as a buffer with its output at pin 14 (TP5) going as XCM signal to the Filament Circuit (CFD 3.0) to give the needed boost to the under-table x-ray tube filament.

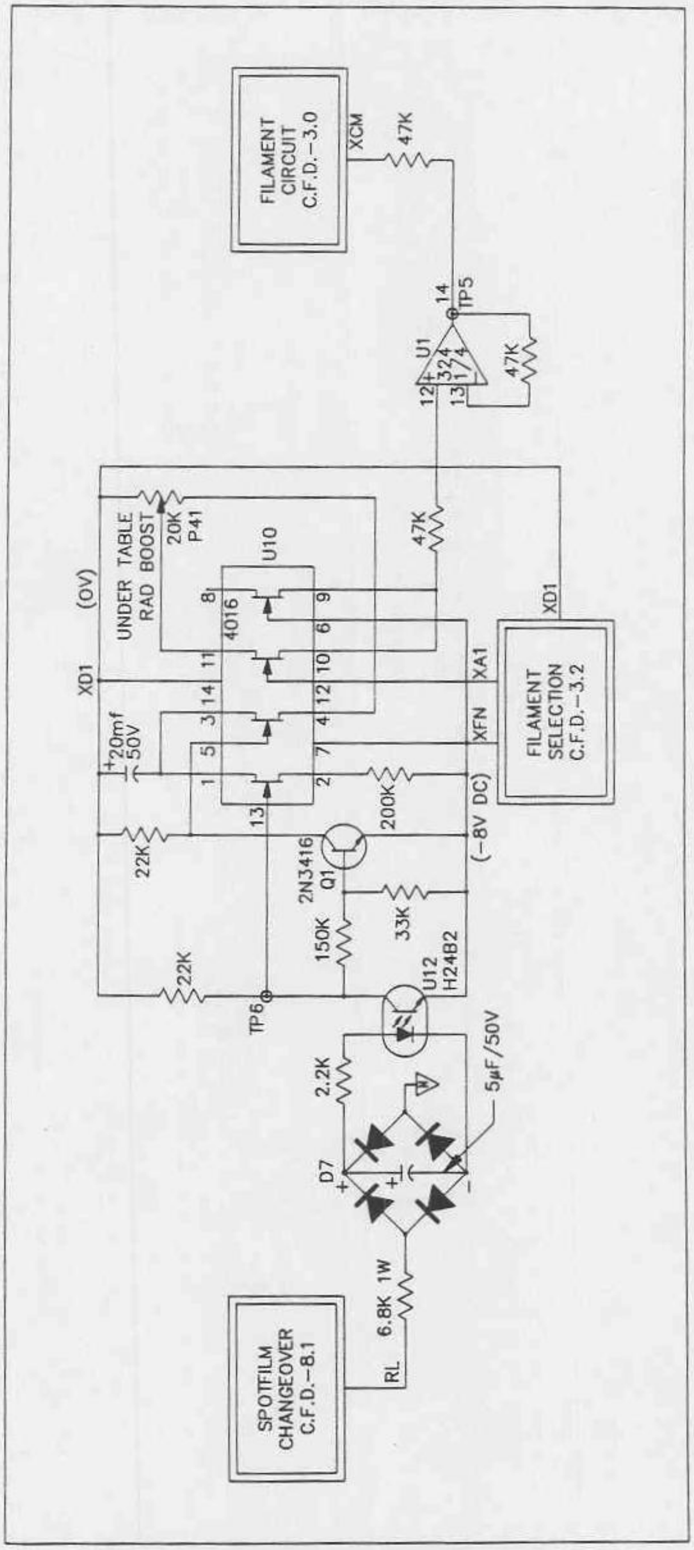

FILAMENT CIRCUIT C.F.D.-3.0
XCM
47K
14
TP5
U1
324 1/4
12
13
47K
UNDER TABLE RAD BOOST
20K P41
(0V)
U10
4016
8
9
6
11
10
14
12
3
4
5
7
1
2
13
47K
XD1
XD1
XA1
XFN
FILAMENT SELECTION C.F.D.-3.2
20mf 50V
22K
200K
(-8V DC)
2N3416 Q1
150K
33K
22K
TP6
U12 H24B2
2.2K
5µF/50V
D7
6.8K 1W
RL
SPOTFILM CHANGEOVER C.F.D.-8.1

FIGURE 2-14 CFD 3.3

2.15 FLUORO RATE CONTROL, CFD 3.4 (FIGURE 2-15)

A total of five (5) values of fluoro radiation is available in two (2) levels, ie., low level and high level. Low level fluoro provides three (3) values of fluoroscopic mA adjustable with the fluoro mA selector in "A", "B" or "C" position to a maximum which would result in a radiation flux of 5 R/MIN. High level fluoro provides two (2) values of fluoroscopic mA adjustable to the maximum allowable radiation level for that particular geographical area.

A two (2) position Footswitch activates fluoro exposure. By depressing the Footswitch to the first detente, fluoro is available up to 5 R/MIN in as measured at the table top. High level fluoro is available only by depressing the Footswitch to the second detente with the fluoro mA selector in the "D" or "E" mA position. When high level fluoro is being produced, an audible tone is heard to warn the operator of high level fluoro radiation.

There are three (3) safety switches that are an integral part of the Spot Film Device. Switch S15 is actuated by fastening the image intensifier mounting plate to its position on the spot film device.

Switches S13 and S14 are maneuvered by the cassette tray mechanism to permit spot film exposures when the cassette is in the "in beam" position and to permit fluoro exposures with the cassette tray in the load/park position. Both S13 and S14 switches are open when the cassette tray is in motion to prevent both fluoro and spot film exposures.

A second EXPOSE switch is provided on the front panel of the spot film device and it is wired in parallel to the Footswitch.

Both fluoro and spot film exposures can be obtained by using this switch; however, only low level fluoro is available from this location.

The low level fluoro mA adjustment potentiometers are: A = P1, B = P2, and C = P3. The high level fluoro mA adjustment potentiometers are: D = P4 and E = P5.

With the Footswitch depressed to the first detente, normally open FE is closed to QFL and, via the spot film device exposure interlock switches, is closed to lead FL.

The relay contacts XDF/XCF remain closed and a portion of the voltage across potentiometers P1, P2, or P3 as selected by XCN exit to the x-ray Filament Circuit (CFD 3.0) on lead XDF. High level fluoro leads XC1 and TLH remain open.

2.15 FLUORO RATE CONTROL, CFD 3.4 (continued)

To obtain high level fluoro, the fluoro mA selector switch must be in the "D" or "E" position and the Footswitch must be depressed to the second detente.

In addition to FE and QFL being closed, normally open TL is closed to TLH which energizes the relay closing the normally open contacts XDF/XC1 and FE/TLB. This provides the voltage from potentiometers P4 or P5 as selected by XC1 to be output to the X-ray Filament Circuit (CFD 3.0).

Also 115 VAC is across FE/TLB to activate the high level warning buzzer whenever high level fluoro is being produced.

NOTE 1. Approximate Fluoro MA at each position of fluoro MA selector switch
- A) 1/4MA
- B) 1/2MA
- C) 1MA
- D) 2MA
- E) 4MA

NOTE 2. Position" C" to be calibrated to MA producing maximum allowable entrance exposure rate (5R/MIN) with maximum KVP (150) at time of installation and periodically thereafter positions A B D and E to be calibrated respectively to produce 1/4, 1/2, 2 and 4 times the MA at maximum KVP calibrated in position C

NOTE 3. Large pedal on footswitch activates x-ray exposure from under table tube in fluoro mode. Low level A B or C exposure rates may be selected. If both stages are activated the MA selector must be in the D or E MA position to obtain the higher level exposure rate.

NOTE 4. S13–Closed in fluoro position.
S14–Closed in radiographic position.
S15–Open when spot device is parked.

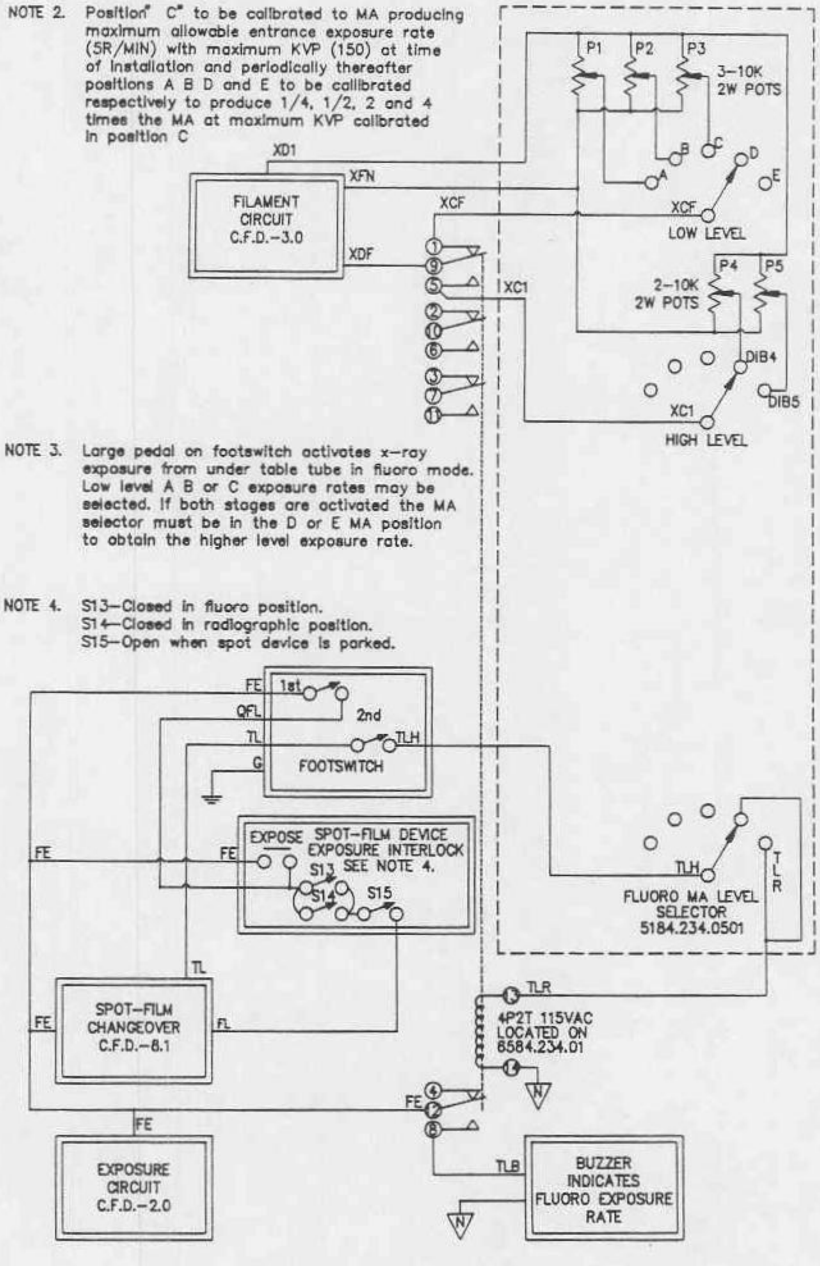

XD1
XFN
FILAMENT CIRCUIT C.F.D.–3.0
XCF
XDF
P1
P2
P3
3–10K 2W POTS
A
B
C
D
E
XCF
LOW LEVEL
P4
P5
2–10K 2W POTS
XC1
DIB4
DIB5
XC1
HIGH LEVEL
FE
QFL
TL
G
1st
2nd
TLH
FOOTSWITCH
EXPOSE
SPOT–FILM DEVICE EXPOSURE INTERLOCK SEE NOTE 4.
S13
S14
S15
TLH
T L R
FLUORO MA LEVEL SELECTOR 5184.234.0501
SPOT–FILM CHANGEOVER C.F.D.–8.1
FL
TLR
4P2T 115VAC LOCATED ON 6584.234.01
N
EXPOSURE CIRCUIT C.F.D.–2.0
TLB
BUZZER INDICATES FLUORO EXPOSURE RATE
N

FIGURE 2-15 CFD 3.4

2.16 KVP METER CIRCUIT, CFD 4.0 (FIGURE 2-16)

2.16.1 RADIOGRAPHIC KVP

An AC voltage from the Power Circuit (CFD 1.0) on leads AC and AM, protected by fuses F3 and F4, and circuit breakers CB23 and CB24 enter into the kVp meter transformer via leads ACKM and AMW. The amplitude of this voltage is dependent upon the kVp selected.

The secondary of this transformer will output a voltage proportional to the major and minor kVp selector switch tap voltage, rectify and filter it. This DC voltage represents the kVp selected.

This pre-read voltage exits the bridge on the positive side on lead MRY to the MA, Time & kVp Overload Circuit (CFD 2.2) and to the kVp meter.

Through step down transformer is 24 VAC on leads 24KA and 24KB, which is rectified and filtered to DC and provides a current source to the offset potentiometers P1-O through P8-O.

An offset and slope combination potentiometers are selected, whenever an mA station is selected. The wiper of the offset potentiometer "taps" off a voltage which is input to the corresponding slope potentiometer through its wiper.

For purpose of discussion, assume the 200L mA selection has been made:

- Normally open contacts MV/MV7 are now closed so a portion of the DC voltage as adjusted by P7-O is further modified by P7-S is on lead MV to the mA, Time & kVp Overload (CFD 2.2) and on the kVp meter.
- The voltage between MRY and MV is the numerical sum of the DC voltage from the kVp transformer, and DC voltage, in phase opposition, from the appropriate Offset Pot.
- The range of the kVp meter is further modified by the appropriate Slope Pot, which adjusts the rate of change of the meter reading with respect to the voltage difference between MRY and MV. This adjusted DC voltage provides an accurate representation of the kVp for each mA station available for overload determination and pre-read kVp display.

2.16.2 FLUOROSCOPIC KVP

From the Power Circuit (CFD 1.0) on leads UF and AQF is a sampling of the fluoro primary voltage. This AC voltage is rectified to DC, adjusted by the 10 KΩ 2 watt pot, and is displayed on the fluoro kVp meter as a pre-read fluoro kVp.

The fluoro kVp meter will read approximately 125 kVp when 200 VAC is measured across leads AQF and AM. As is the case with all kVp reading devices, the final calibration is performed with a high voltage divider measuring device in the x-ray tube High Tension Circuit.

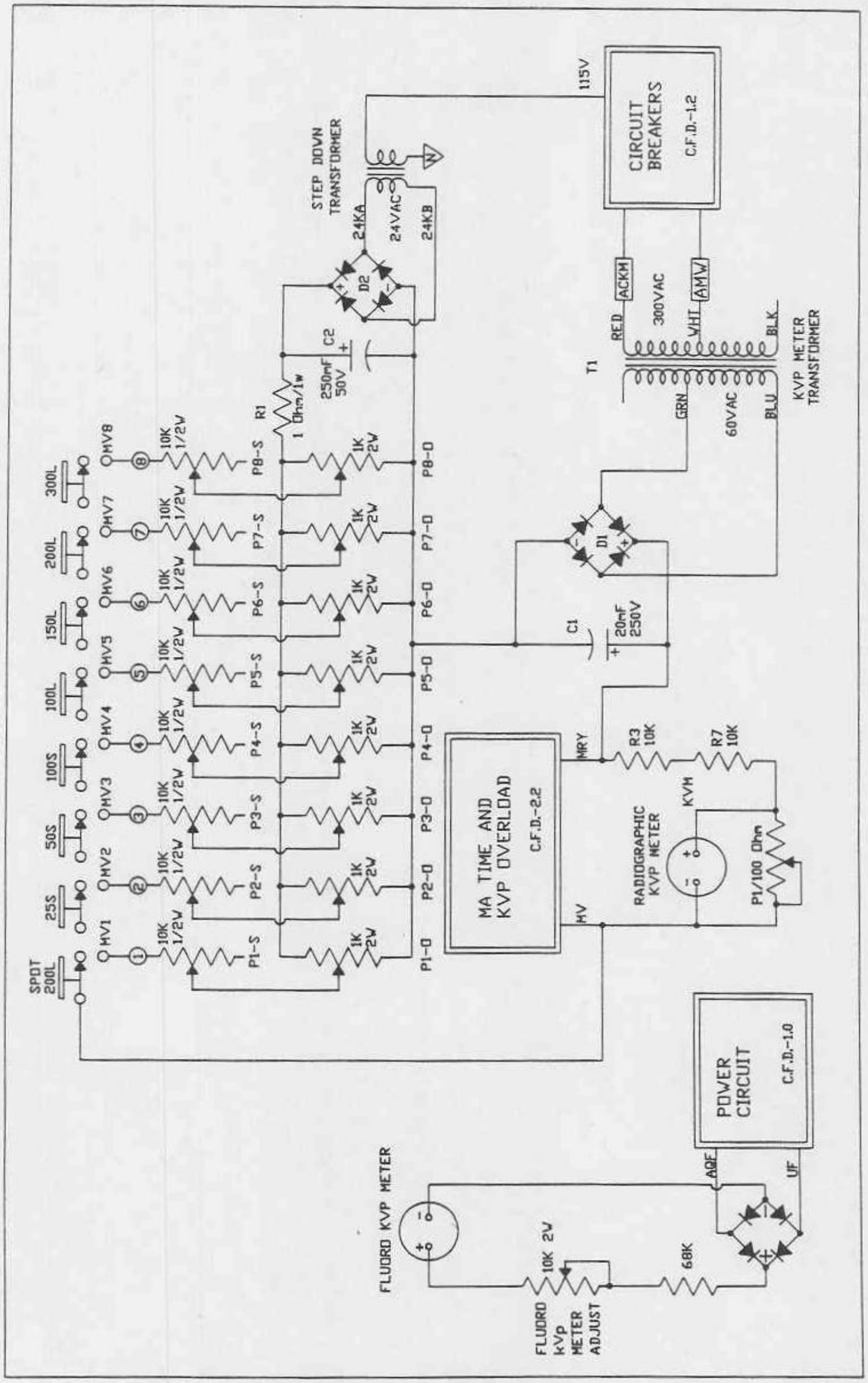

CIRCUIT BREAKERS
C.F.D.-1.2
115V
STEP DOWN TRANSFORMER
24KA
24VAC
24KB
D2
C2
250mF 50V
R1
1 Ohm/1W
ACKM
AMW
RED
300VAC
WHT
BLK
T1
GRN
60VAC
BLU
KVP METER TRANSFORMER
D1
C1
20mF 250V
MA TIME AND KVP OVERLOAD
C.F.D.-2.2
MRY
HV
R3 10K
R7 10K
KVM
RADIOGRAPHIC KVP METER
P1/100 Ohm
SPDT 200L
25S
50S
100S
100L
150L
200L
300L
HV1
HV2
HV3
HV4
HV5
HV6
HV7
HV8
10K 1/2W
1K 2W
P1-S
P2-S
P3-S
P4-S
P5-S
P6-S
P7-S
P8-S
P1-O
P2-O
P3-O
P4-O
P5-O
P6-O
P7-O
P8-O
POWER CIRCUIT
C.F.D.-1.0
AQF
UF
FLUORO KVP METER
10K 2W
68K
FLUORO KVp METER ADJUST

FIGURE 2-16 CFD 4.0

2.17 MA METER & SHUNT CIRCUIT, CFD 5.0 (FIGURE 2-17)

The mA meter is a 1 mA full scale device, scaled for three (3) DC mA ranges of current indication, 0-10 mA, 0-100 mA and 0-400 mA. With this arrangement, all radiographic mA selections will indicate within the central half of the meter from 1/4 scale to 3/4 scale.

The indicating range is selected by providing three (3) adjustable meter shunts, which when selected, parallel the meter and pass the majority of the x-ray tube current around the meter.

The system is configured so the meter shunt of interest is actually in parallel to the combination of the focal spot overload sensor and the mA meter connected in series. The focal spot overload sensor is adjusted to 6000 Ω, and the mA meter has an internal resistance of approximately 80 Ω. This combination produces a series resistance of 6080 Ω. At 1 mA meter current, the voltage across the combination is 6.08 volts for a full scale meter indication.

The meter shunts are sized to pass the remainder of the x-ray tube current. On the 10 mA scale, the shunt resistance is approximately 675 Ω, on the 100 mA scale 61.4 Ω and on the 400 mA scale, 15.2 Ω.

The approximate shunt for the expected mA range is selected through a relay pole series on the mA Relay Selector Circuit Board.

When the fluoro spot film mode is selected, two (2) different shunts must be selected dependent on the mode of operation. When fluoro is active, the 0-10 mA scale is selected via a relay on the Spot Film Changeover to pass the shunt current through lead MMF to the low current mA meter shunt.

When the radiographic mode is selected by advance of the spot film device cassette carrier, the shunt current passes through lead MS1. Lead MS1 connects to a jumper which provides selection of either the middle shunt range for spot radiographic mA of 25 to 75 mA, or the high current shunt for mA of 100 to 300. This provides for field selection of the spot radiographic mA.

The mA meter shunt is calibrated using a DC current source set to the appropriate mA selection indicator. The variable potentiometer is adjusted so the meter indicates the correct mA.

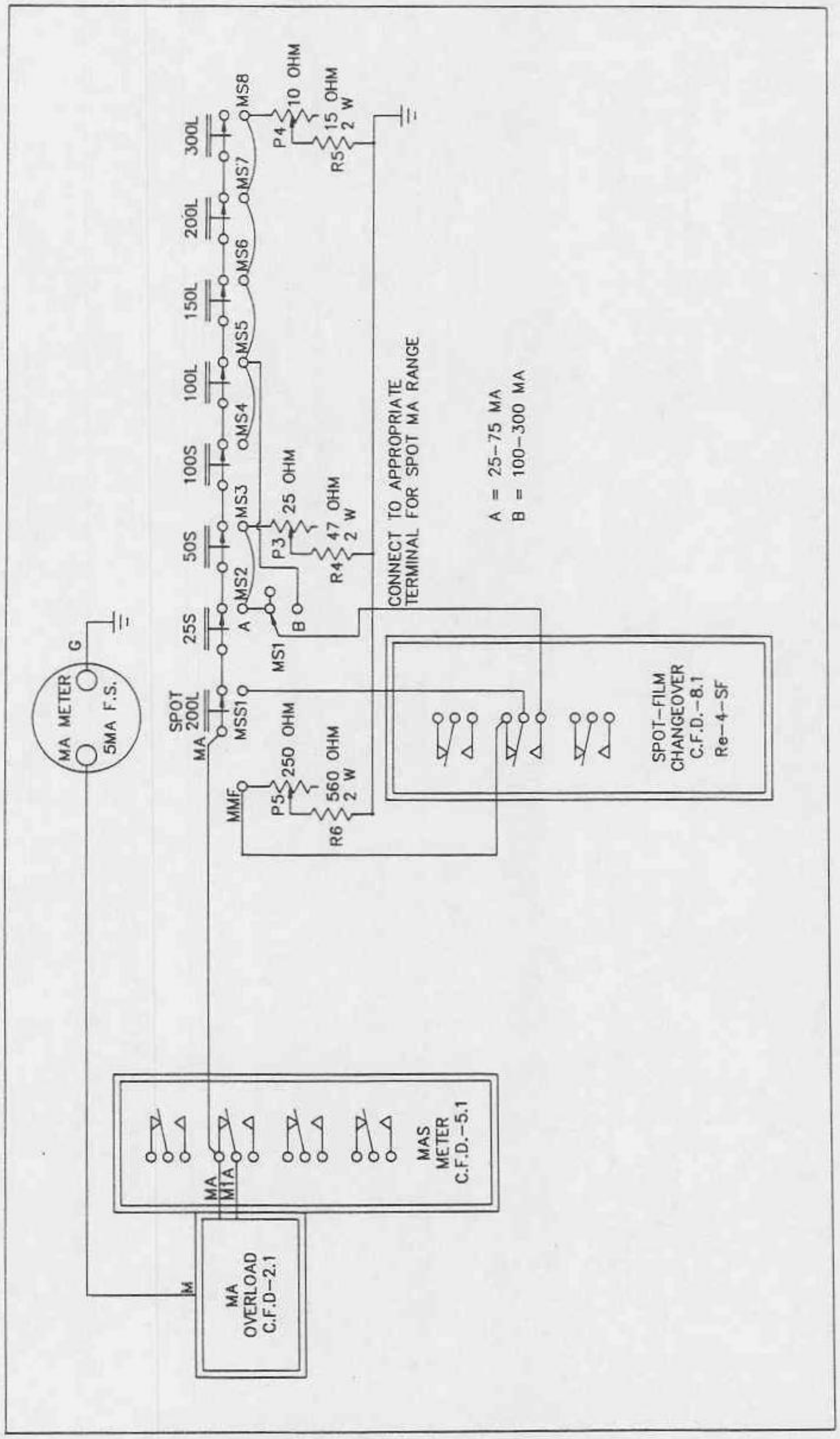

MA METER
5MA F.S.
G
SPOT 200L
MA
MSS1
25S
MS1
A
B
MS2
50S
MS3
100S
MS4
100L
MS5
150L
MS6
200L
MS7
300L
MS8
P4
10 OHM
R5
15 OHM 2 W
P3
25 OHM
R4
47 OHM 2 W
CONNECT TO APPROPRIATE TERMINAL FOR SPOT MA RANGE
A = 25–75 MA
B = 100–300 MA
MMF
P5
250 OHM
R6
560 OHM 2 W
SPOT–FILM CHANGEOVER C.F.D.–8.1
Re–4–SF
MA
MTA
MAS METER C.F.D.–5.1
M
MA OVERLOAD C.F.D–2.1

FIGURE 2-17 CFD 5.0

2.17 MA METER & SHUNT CIRCUIT, CFD 5.0 (continued)

Using the 200L mA selection and assuming the x-ray exposure is exactly 200 mA and the mA shunt potentiometers are accurately adjusted, the following current paths are used for mA indication:

- from the mA Overload (CFD 2.1) on lead M1 is 200 ma from the x-ray tube;
- through the meter M1 Overload Circuit to leads M1A/MA across normally closed contacts of the mAs meter assembly;
- where it splits with shunt current fraction going towards the mA shunt potentiometers.
- The remaining current going back to the mA Overload Circuit (CFD 2.1).
- The current returns from the mAs Meter Circuit (CFD 5.1, FIGURE 2-18) on lead M to the mA meter to ground.

The shunt current flows:

- across the normally open, now closed contacts MA/MSS7;
- across mA Shunt potentiometer P7;
- and the 10 Ω, 2 watt resistor R5 to ground.

When the fluoro Footswitch is depressed and a fluoro exposure is initiated, mA through mA to M1A from the mA Overload (CFD 2.1) is:

- across normally closed contacts M1A/MA of relay R1 of the mAs Meter Circuit (CFD 5.1);
- across normally open, now closed contacts MA/MSS1 of the 200L SPOT film mA select push button;
- to the normally closed MSS1/MMF contacts Re-4-SF on the Spot Film Changeover (CFD 8.1, FIGURE 2-23);
- across the low Current Meter Shunt P6, R6;
- across the mA meter.

2.17 MA METER & SHUNT CIRCUIT, CFD 5.0 (continued)

When a spot film exposure is initiated, Re-4-SF on the Spot Film Changeover is energized closing normally open contacts MSS1/MS1 and mA Shunt potentiometer P7 is inserted into the mA Circuit. The Meter Shunt current is now through P7, R5 to ground.

2.18 MAS METER CIRCUIT, CFD 5.1 (FIGURE 2-18)

When the operator desires to know the mAs of a particular exposure, the provision is made for that purpose using the mAs meter. A push button switch on the function selection switch assembly is depressed which routes the x-ray tube mA through the mAs sensing assembly.

From lead 15MS from Circuit Breakers (CFD 1.2) is 115 VAC to a step down transformer T1 to 24 VAC which is half wave rectified, filtered and zenered to a positive (+) and negative (-) 6 VDC. These DC voltages supply the op-amp U2, the analog switch U1, and the transistor portion of the optocoupler OC1.

With the MAS push button switch depressed, 115 VAC comes across the coil of relay R1 energizing it and closes the normally open contacts M1A/MS and 15MS/MTC. When contacts M1A/MS close, a R8 sensing resistor is inserted between MS and MA.

With the relay R1 contacts 15MS/MTC closed, 115 VAC is now rectified, filtered, and is across the LED portion of the optocoupler OC1 causing it to conduct. This puts a low on pin 13 of the analog switch U1 opening the discharge path for the C2 integrator capacitor.

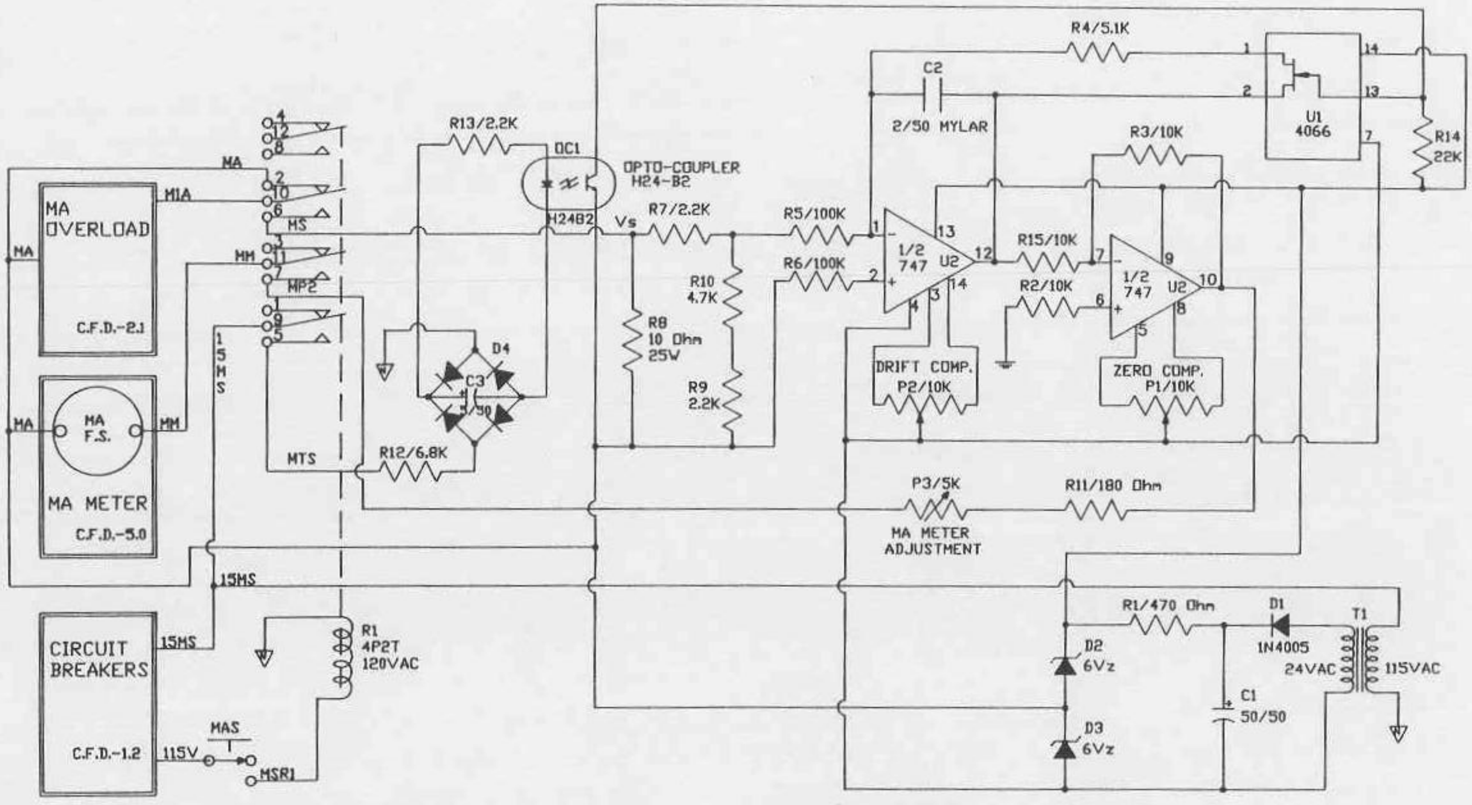
This capacitor connected across one section of the U2 dual op-amp in an integrator configuration will change the time integral of the voltage developed across the sensing resistor R8. The voltage, developed across the capacitor C2 by the accumulated charge, is an input into the op-amp U2. Its output is across closed relay R1 contacts MP2/MM, and is read as mAs on the mA meter.

The reading on the mAs meter scale will remain as long as the MAS push button is depressed.

During an exposure, x-ray tube mA is across closed relay R1 contacts M1A/MS and develops a voltage known as VS which will be 1 volt per 100 mA.

Releasing the MAS push button switch turns off the optocoupler OC1, putting a high on pin 13 of the switch U1 and closing pins 1 and 2. That allows the integrator capacitor C2 to discharge through a resistor R4.

The adjustments for the mAs meter are: Drift Compensation potentiometer P2 to prevent drifting of the mAs reading; Zero Compensation potentiometer P1 to provide an offset voltage for zero (0) mAs, and mA Meter Adjustment potentiometer P3 for calibrating the meter for a known mAs exposure.


MA
OVERLOAD
C.F.D.-2.1
MIA
MA
MA
F.S.
MA METER
C.F.D.-5.0
MM
MA
CIRCUIT
BREAKERS
C.F.D.-1.2
15MS
115V
MAS
MSR1
4
12
8
2
10
6
MS
3
11
7
MM
MP2
1
9
5
1
5
M
S
MTS
15MS
R1
4P2T
120VAC
R13/2.2K
OC1
OPTO-COUPLER
H24-B2
H24B2
D4
C3
50
R12/6.8K
Vs
R7/2.2K
R8
10 Ohm
25W
R10
4.7K
R9
2.2K
R5/100K
R6/100K
1
2
13
12
14
3
4
1/2
747
U2
DRIFT COMP.
P2/10K
C2
2/50 MYLAR
R4/5.1K
R3/10K
R15/10K
R2/10K
7
6
9
10
8
5
1/2
747
U2
ZERO COMP.
P1/10K
U1
4066
1
2
14
13
7
R14
22K
P3/5K
MA METER
ADJUSTMENT
R11/180 Ohm
R1/470 Ohm
D1
1N4005
T1
24VAC
115VAC
C1
50/50
D2
6Vz
D3
6Vz

ADJUSTMENT PROCEDURE.
1. ADJUST 'P1' FOR ZERO.
2. MAKE EXPOSURE, ADJUST 'P2' SO READING DOES NOT DRIFT WITH MAS BUTTON DEPRESSD.
3. MAKE ANOTHER EXPOSURE AT KNOWN MA & TIME MAS < 100 MAS ADJUST 'P3' FOR CORRECT READING.
4. Vs ≈ 1 VOLT PER 100 MA.

FIGURE 2-18 CFD 5.1

2.19 SINGLE PHASE IMPULSE TIMER CIRCUIT, CFD 6.0 (FIGURE 2-19)

Power for the Timer Circuit is supplied by the SCR Timer Contactor (CFD 6.3, FIGURE 2-21). The supplies are positive (+) 20 VDC 12 VAC. All voltages are referenced to the system common "N".

- The 12 VAC supply is fed to an AC input of optocoupler OC1.
- The output of OC1 is coupled directly to one section of U1, a quad XOR gate, which buffers and inverts the signal.
- The output is shaped by R9 and C4 and applied to the clock input of flip-flop pin 3 of U2.
- The clock pulses are again inverted by another XOR gate of U1 and become one of the inputs to each of the triple input NAND gates contained in U3.
- The 12 VAC supply is also rectified, clipped and shaped by the combination of D1, D2, D3, R3 and R2.
- The resulting wave form is applied to the CLR pin 4 of flip-flop contained in U2.

  This synchronizes the flip-flop so that its output is in phase with the AC line.

- The output of flip-flop U2 pin 2 is a square wave which cycles at the same rate as the line frequency whenever the system is turned on. This output is compared with the output of flip-flop U2 pin 12 by an XOR gate in U1.
- Flip-flop U2 pin 12 is only clocked during an exposure, so that the output of the XOR gate U1 pin 10 will alternate at the same rate as flip-flop U2 pin 1 except only during an exposure.

  This insures that each successive exposure will begin on the opposite phase of the AC line from the last impulse of the previous one.

2.19 SINGLE PHASE IMPULSE TIMER CIRCUIT, CFD 6.0 (continued)

An exposure timing sequence begins with the application of 115 VAC from H6T to optocoupler OC2.

- This causes the emitter output of OC2 to go high, raising the Reset pin 10 of timer in U4 above 0.8 VDC and applying a high signal to an input of the first triple input NAND gate U3 as well as to Q4 and Q3 on the SCR Contactor.
- The last generates the BAM signal to the Backup Timer (CFD 6.2). OC2 also supplies the signal to another XOR gate of U1 which acts as a non-inverting buffer to control the reset pin 4 of timer U4 in section 2.
- When the timer resets are high, the both timers U4 may be triggered to begin timing.
- When the Expose, Phase, and Clock signal inputs to the first triple input NAND gate are all simultaneously high, the output goes low, causing the Trigger input pin 8 to timer 1 U4 to go low and turn on the output (pin 9), which goes high.
- Because the threshold pin 12 of U4 timer 1 is tied to common, the output will remain on until the timer is reset by removal of the Exposure signal from H6T.
- The output (pin 9) of U4 timer 1 turns on and gate of transistor Q2, which causes a negative going pulse to the U4 Trigger input (pin 6) of timer 2. This pulse causes timer 2 to turn on.
- The output of timer 2 (GPS) provides:
  - the turn on signal to the SCR Contactor (CFD 6.3, FIGURE 2-21);
  - the gating signal for Q1 which gates Q6 and Q5 on the SCR Contactor to provide the BAS (Exposure On) signal;
  - and the input to a triac optocoupler OC4 which illuminates the EXPOSE button.
  - Additionally, GPS is connected to the second triple input NAND gate U3, allowing the clock pulses clock flip-flop 2 U2 for the duration of the exposure.

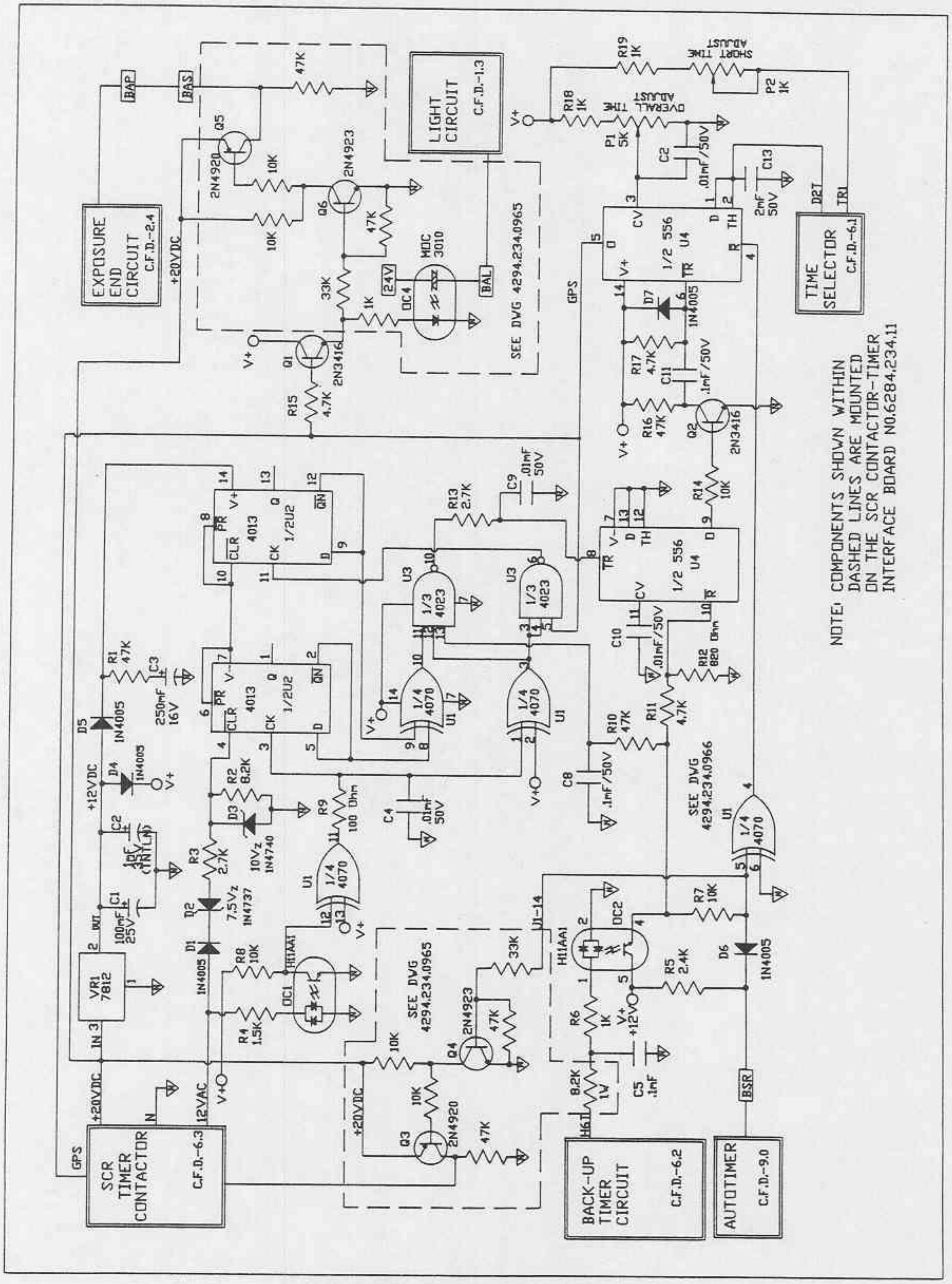

EXPOSURE END CIRCUIT C.F.D.-2.4
LIGHT CIRCUIT C.F.D.-1.3
TIME SELECTOR C.F.D.-6.1
SCR TIMER CONTACTOR C.F.D.-6.3
BACK-UP TIMER CIRCUIT C.F.D.-6.2
AUTOTIMER C.F.D.-9.0
SEE DWG 4294.234.0965
SEE DWG 4294.234.0966
OVERALL TIME ADJUST
SHORT TIME ADJUST
1/2 556 U4
4013 1/2U2
1/3 4023 U3
1/4 4070 U1
VR1 7812
MOC 3010
H11AA1
2N4920
2N4923
2N3416
BAP
BAS
BAL
BSR
GPS
+20VDC
+12VDC
12VAC
NOTE: COMPONENTS SHOWN WITHIN DASHED LINES ARE MOUNTED ON THE SCR CONTACTOR-TIMER INTERFACE BOARD NO.6284.234.11

FIGURE 2-19 CFD 6.0

2.19 SINGLE PHASE IMPULSE TIMER CIRCUIT, CFD 6.0 (continued)

The exposure terminates when C13, the timing capacitor for the U4 timer 2, charges to a voltage equivalent to that set by the potentiometer P1 through the resistance selected by the timer switch.

In the case of phototimed exposures, a back-up time longer than the expected time is set on the timer switch and the exposure is terminated by the automatic exposure control pulling the BSR signal Low. This causes the associated XOR gate to pull the reset pin on timer 2 low, thus terminating the exposure.

The exposure cannot be restarted until 115 VAC is removed from H6T, which resets U4 timer 1.

The Overall Time Adjust potentiometer P1 is used for setting overall timing accuracy at longer times. The Short Time Adjust potentiometer P2 is used for precise timing at short times (1/60 - 1/30 sec).

2.20 TIME SELECTOR SWITCH

The timer is an analog type timer using an RC combination. On the Impulse Timer Deck of the time selector switch are 24 resistors connected in series which form the "R" part of the Timing Circuit. As the selected time is increased, the total resistance is increased because a greater number of series connected resistors are selected.

These resistors are inserted into the charging path of a C13 - Timer capacitor shown on the Single Phase Impulse Timer Circuit (CFD 6.0) in lead D2T.

The voltage across the Impulse Timer Deck is some portion of positive (+) 12VDC as adjusted by the Short Time Adjust potentiometer (P2) shown on the Single Phase Impulse Timer Circuit (CFD 6.0). This positive voltage is on leads TR1 and D2T.

The Back-up Timer deck of the time selector switch utilizes resistors in the same manner as the Impulse Timer deck. As the selected Back-up time increases, so the total resistance increases.

The Back-up Timer allows an approximately 10% increase in exposure time 1 at 50 Hz, in the event of failure of the Impulse Timer. The time increase will be greater at 60 Hz. The appropriate Back-up time is automatically selected as the regular exposure time is selected. These resistors are inserted into the charging path of a C1 capacitor shown on the Back-up Timer Circuit (CFD 6.2, FIGURE 2-20) in lead DBR.

The voltage across the Back-up Timer Deck is some portion of positive (+) 24 VDC as adjusted by potentiometer R2 shown on the Back-up Timer Circuit. This positive voltage is on leads DBR and 3D.

The remaining deck of the time selector switch acts as an interlock to the mA Overload (CFD 2.1). From lead ERR is 115 VAC across the timer switch contacts, and exits to lead ERX. When the time selector is on the open contacts of the deck, the SAFETY RESET lamp illuminates to show that an improper technique has been entered into the control.

It also disallows an exposure from being accomplished.

2.21 BACK-UP TIMER, CFD 6.2 (FIGURE 2-20)

The Back-up Timer operates in two modes. The first is normal exposure, when the Back-up Timer causes the Back-up Contactor to pull in prior to the beginning of an exposure, and releases the Back-up Contactor after the SCR Contactor turns off. During phototiming, if the phototimer terminates the exposure prior to time out, the Back-up Contactor does not release. The second mode provides for exposure interruption by releasing the Back-up Contactor immediately when the overload condition is detected.

Upon the initiation of the PREP function (or cassette advance during spot filming), signal H3 from Exposure Circuit (CFD 2.0) goes to 115 VAC, energizing relay K4. K4 opens the filament standby shunt through contacts XBR/XD, bringing the tube filament to full emission.

After the Rotor Control has completed its boost cycle and the tube anode is up to speed, signal OHO from the Rotor Control (CFD 7.0) energizes signal BUC through the Interlock & Safety relay (CFD 2.0). This causes the Back-up Contactor K2 to close through relay K3 contacts BUC/BUL and through relay Re-4-BT contacts BUL/BPL. When the EXPOSE button is pressed:

- H6 (Rotor Control CFD 7.0) goes to 115 VAC and becomes H6T, after passing through contacts H6/H6T of the relay Re-4-BT.

- H6T then goes to the Impulse Timer (CFD 6.0). Signal BAM from the Impulse Timer immediately goes high, activating relay K1.

- This removes the short from the Back-up Timer capacitor C1, and the cathode of the SCR connects to the common.

- Timing immediately commences, with C1 charging through selected resistors on the timer switch, and potentiometer R2.

- When C1 charges to a voltage to the reference set by the potentiometer R9, the unijunction transistor Q2 discharges the capacitor C1 through its emitter/base junction, providing a gating signal to the SCR.

- The SCR turns on, activating relay K3. This causes BUC to break from BUL and switch to BPT, forcing the Back-up Contactor K2 to release and relay Re-4-BT to energize.

- Contacts XBR/XD are also made, which the filament standby resistor to be returned to the circuit and reduce the filament to standby level.

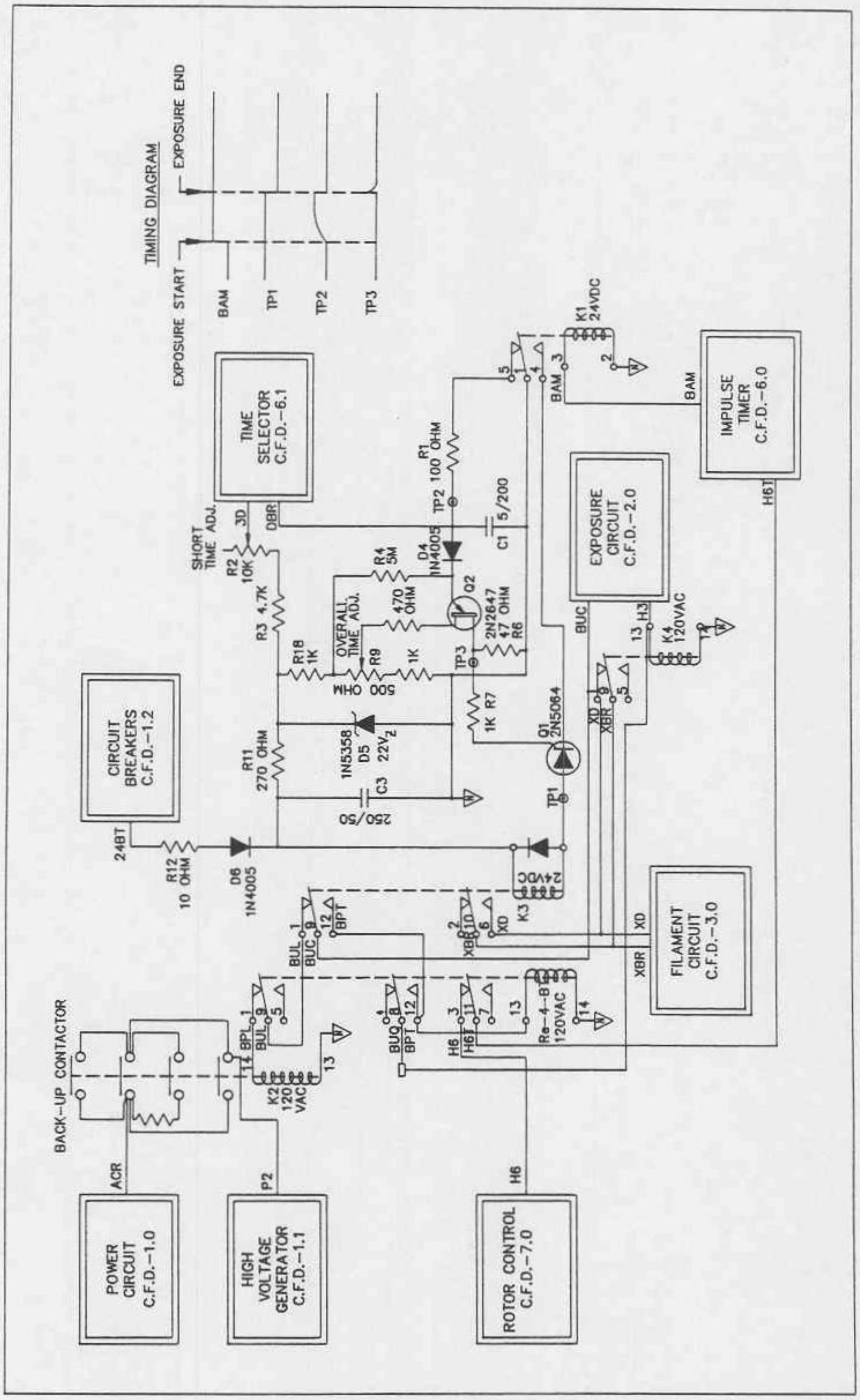

TIMING DIAGRAM
EXPOSURE START
EXPOSURE END
BAM
TP1
TP2
TP3
TIME SELECTOR C.F.D.-6.1
SHORT TIME ADJ.
3D
DBR
R2 10K
R3 4.7K
R18 1K
OVERALL TIME ADJ.
R9
500 OHM
1K
470 OHM
R4 5M
D4 1N4005
Q2 2N2647
47 OHM R6
TP3
TP2
R1 100 OHM
C1 5/200
K1 24VDC
BAM
IMPULSE TIMER C.F.D.-6.0
H6T
EXPOSURE CIRCUIT C.F.D.-2.0
BUC
K4 120VAC
H3
13
14
XD
XBR
CIRCUIT BREAKERS C.F.D.-1.2
24BT
R12 10 OHM
D6 1N4005
R11 270 OHM
C3 250/50
1N5358 D5 22V 1/2
1K R7
Q1 2N5064
TP1
K3 24VDC
BPT
BUL 1
BUC
XBR
XD
FILAMENT CIRCUIT C.F.D.-3.0
BACK-UP CONTACTOR
BPL 1
BUL
K2 120 VAC
BUQ
BPT
H6
H6T
Re-4-B 120VAC
ACR
P2
H6
POWER CIRCUIT C.F.D.-1.0
HIGH VOLTAGE GENERATOR C.F.D.-1.1
ROTOR CONTROL C.F.D.-7.0

FIGURE 2-20 CFD 6.2

2.21 BACK-UP TIMER, CFD 6.2 (continued)

Concurrently Re-4-BT is energizes by BPT. This causes contacts H6/H6T to break, terminating the exposure signal to Impulse Timer (CFD 6.0).

When automatic exposure control is employed and terminates the exposure, BAM immediately goes low, deactivating relay K1. This shorts the timing capacitor C1 and inhibits completion of timing cycle. In these circumstances, the Back-up Contactor K2 remains engaged until signal H3 (Exposure Circuit CFD 3.0) is released by releasing the PREPARE button or advancing the cassette to the Parked (fluoro) position during spot filming.

The voltage level on charging capacitor at which the unijunction transistor triggers the SCR is adjusted by potentiometer R9 Overall Time Adjust. This adjustment provides a proportional increase or decrease in the Back-up time interval for each time selection. Potentiometer P2 Short Time Adjust is in the charging resistor path. It increases or decreases the timer interval by fixed amount for each time selection.

2.22 SINGLE PHASE SCR CONTACTOR CIRCUIT, CFD 6.3 (FIGURE 2-21)

From leads 15IT and "N" (Circuit Breakers CFD 1.2) comes 115VAC to the transformer leads BLK and WHT. One (1) secondary operates as a DC power supply while the other two (2) secondaries develop the DC gate voltages for SCR-1 and SCR-2. When these SCRs are turned on, the AC voltage from the Power Circuit (CFD 1.0) on lead AM passes through the SCRs and becomes lead AMR to the high voltage generator (CFD 1.1).

Across transformer leads RED and VIO is about 48 VAC center tapped by the GRN lead. This voltage is rectified, filtered, and regulated becoming a positive (+) 20VDC source to the Impulse Timer Circuit (CFD 6.0). From VIO lead is 12 VAC also to the Impulse Timer Circuit.

The remaining two (2) secondaries, leads BLU/BLU and GRY/GRY, are identical in operation. The AC voltage is rectified by the diode bridges, capacitive filtered, and is controlled by optocouplers OC2, OC3 and transistors Q7, Q8.

When an exposure is initiated, leads BAM/BAC from the Impulse Timer Circuit (CFD 6.0) is high causing the optocoupler OC1 to conduct. High on the lead GPS (Impulse Timer Circuit CFD 6.0) turn on the two optocouplers OC2 and OC3.

The optocouplers conduct the DC voltage to the base of the transistors Q7 and Q8, biasing them on and passing a DC voltage from collector to emitter to the gates of SCR-l and SCR-2. This gate voltage is about 1. 5 VDC.

Since the duty cycle of the SCRs is 100%, both positive and negative cycles pass through to lead AMR.

When the timers terminate exposure, leads BAM/BAC and GPS return low, the optocouplers and transistors are turned off removing the DC gate voltage to the SCRs. The SCRs continue to conduct until the next zero crossover of incoming AC voltage on lead AM and then they inhibit.

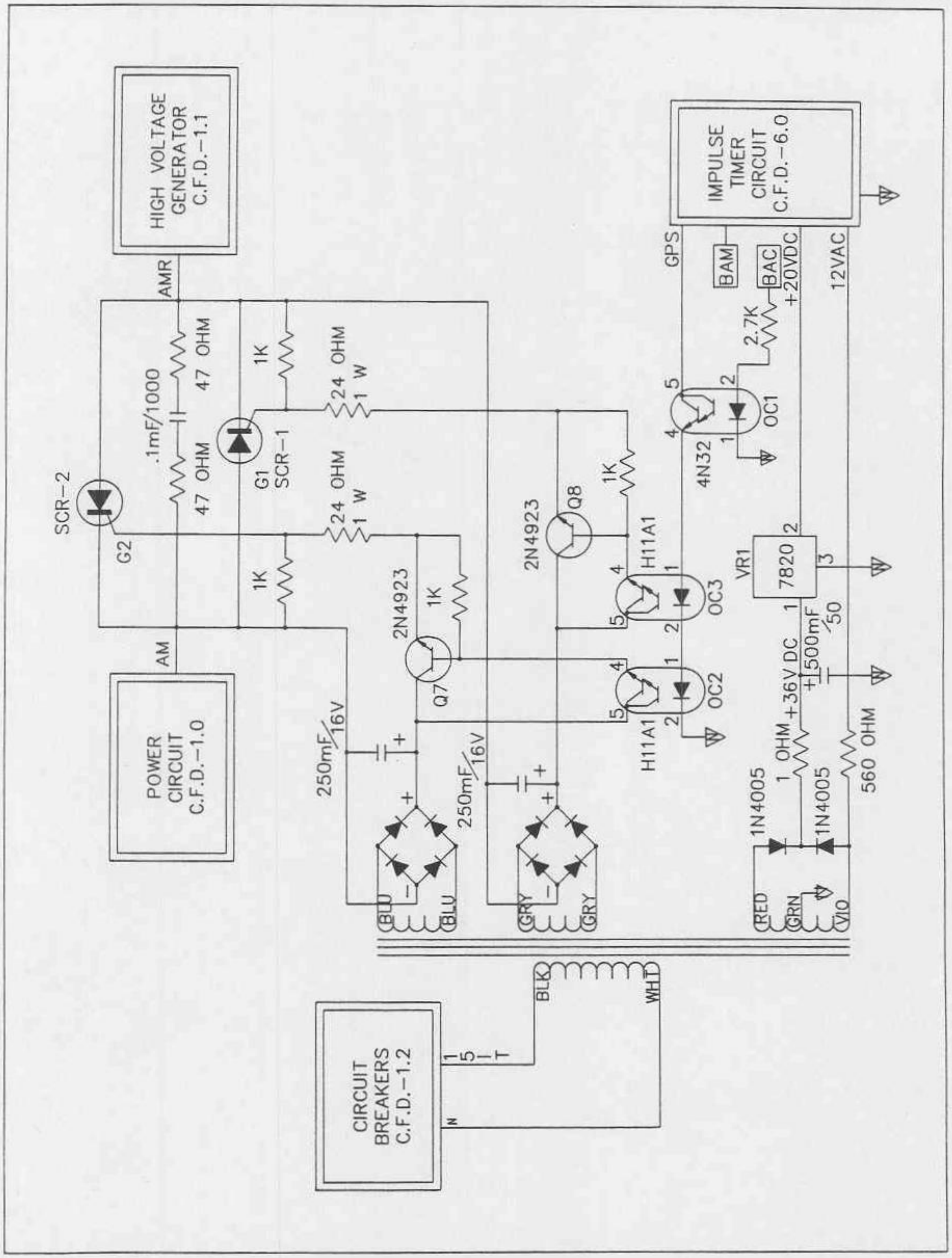

HIGH VOLTAGE GENERATOR C.F.D.-1.1
AMR
IMPULSE TIMER CIRCUIT C.F.D.-6.0
GPS
BAM
BAC
+20VDC
12VAC
2.7K
5
2
4
1
4N32
OC1
SCR-2
G2
.1mF/1000
47 OHM
47 OHM
1K
G1
SCR-1
24 OHM 1 W
24 OHM 1 W
1K
1K
1K
2N4923
Q8
H11A1
OC3
VR1
7820
3
500mF/50
+36V DC
2N4923
Q7
1K
H11A1
OC2
AM
POWER CIRCUIT C.F.D.-1.0
250mF/16V
250mF/16V
1N4005
1N4005
1 OHM
560 OHM
BLU
BLU
GRY
GRY
RED
GRN
VIO
BLK
WHT
CIRCUIT BREAKERS C.F.D.-1.2
1 5 T
N

FIGURE 2-21 CFD 6.3

2.23 ROTOR CONTROL CIRCUIT, CFD 7.0 (FIGURE 2-22)

Both x-ray tubes: over-table and under-table, are controlled by this controller. The controller starts the anode of the x-ray tube spinning, reduces the voltage across the stator winding of the x-ray tube after a pre-set period of time, maintains a sensing circuit for monitoring the voltage and current of the phase shift capacitor, and removes the stator voltage at the end of the exposure.

A jumper wire between leads HF and FE make the provision for continuous rotation of the under-table tube possible. If continuous rotation is not desired, then the jumper is to be across HF and H3. It is highly recommended to have continuous rotation on the under-table tube whenever it is in use.

Re-4 tube select 4PDT relay is used to connect either the over-table or under-table x-ray tube to the rotor controller. This relay is operated via lead FE. When lead FE is 115 VAC, the relay is energized and the under-table tube is selected. If lead FE is low, then the over-table tube is selected.

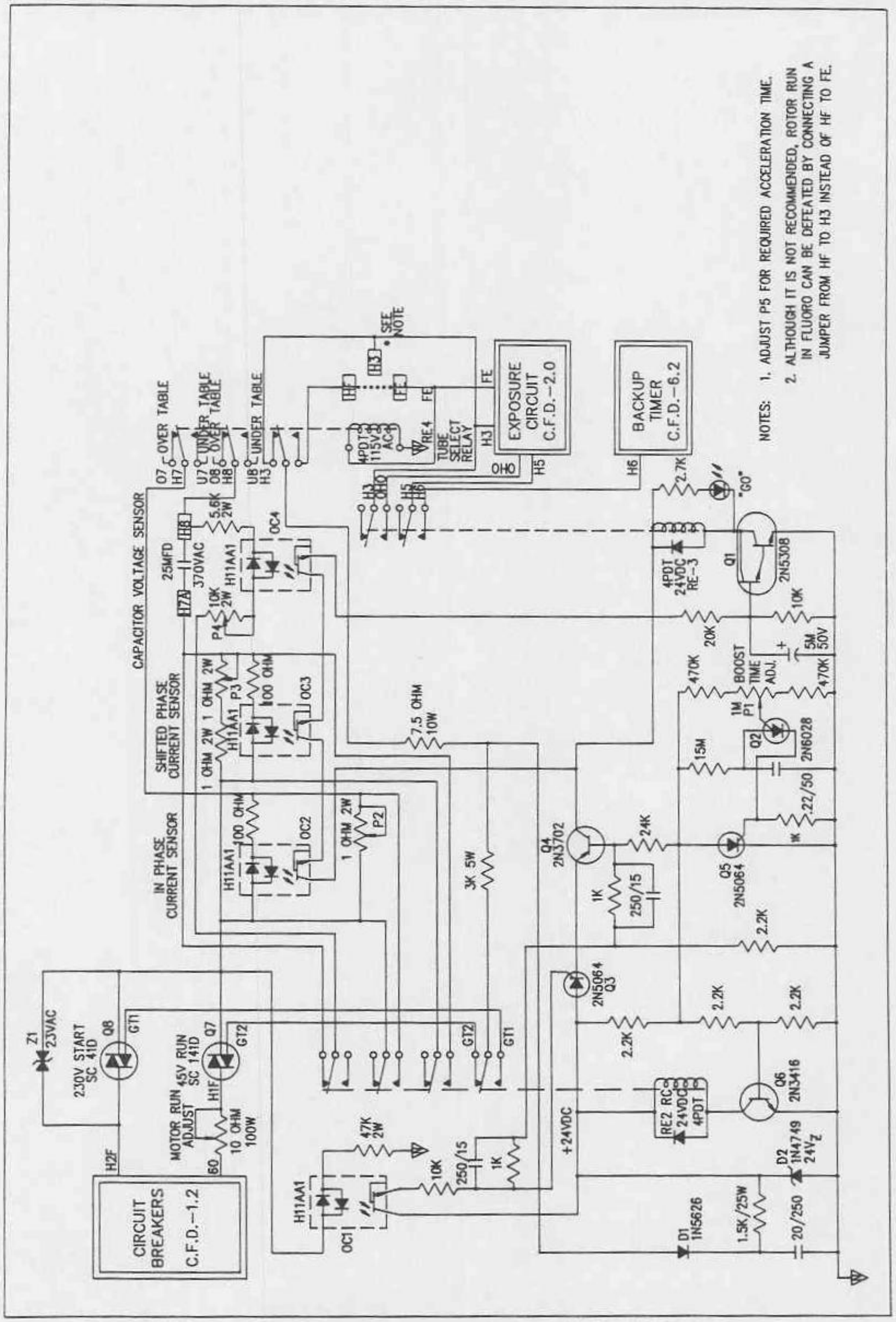
The operation of the Rotor Control is initiated by depressing the PREPARE push button in radiography and by depressing the Footswitch in fluoro mode. For this discussion, assume the over-table tube is in use and the PREPARE push button is depressed for a radiographic exposure.

From the Exposure Circuit (CFD 2.0) via the PREPARE push button is 115 VAC on lead H3 which branches into two (2) circuits. One (1) circuit is to a set of normally closed contacts on the 4PDT relay Re-3 energized when the rotor reaches speed which illuminates the "GO" LED.

The other circuit for lead H3 is through a set of normally closed contacts on the tube select relay Re-4 to the common pin of contact GT1 and GT2 on relay Re-2-RC and also is rectified, filtered, and zenered to become the positive (+) 24 VDC source. This 24 VDC source turns on transistor Q2 which allows Re-2-RC to energize closing contacts H3/GT1 and the remaining three (3) sets of normally open contacts close to short circuit the sensors during boost time.

Across the Boost Time Adjust potentiometer P1 and its series resistors is 24 VDC and it is across a 15 MΩ resistor in series with the 0.1 mFd Timing capacitor. Potentiometer P1 sets the trip point and turns on SCR2 to change from boost cycle to RUN cycle.

During the boost cycle and while the timing capacitor is charging, 115 VAC is across the closed contacts H3/GT1 to GT1 triac and causes it to conduct. From lead H2F comes 230 VAC through GT1 triac to the closed contacts Re-4 H7/07.


CIRCUIT BREAKERS C.F.D.-1.2
H2F
60
MOTOR RUN ADJUST
10 OHM 100W
H1F
Z1 23VAC
230V START SC 41D
Q8
GT1
45V RUN SC 141D
Q7
GT2
H11AA1
OC1
47K 2W
10K
250/15
1K
+24VDC
D1 1N5626
1.5K/25W
20/250
D2 1N4749 24V
RE2 RC 24VDC 4PDT
Q6 2N3416
2.2K
2N5064 Q3
2.2K
2.2K
IN PHASE CURRENT SENSOR
H11AA1
100 OHM
OC2
1 OHM 2W
P2
3K 5W
Q4 2N3702
1K
250/15
24K
Q5 2N5064
2.2K
1K
22/50
SHIFTED PHASE CURRENT SENSOR
1 OHM 2W
1 OHM 2W
H11AA1
P3
100 OHM
OC3
7.5 OHM 10W
15M
Q2 2N6028
1M P1
BOOST TIME ADJ.
470K
470K
5M 50V
20K
10K
CAPACITOR VOLTAGE SENSOR
H7A
25MFD 370VAC
H8
10K 2W
P4
H11AA1
5.6K 2W
OC4
4PDT 24VDC RE-3
Q1 2N5308
2.7K
"GO"
O7 OVER TABLE
H7
U7 UNDER TABLE
O8 OVER TABLE
H8
U8 UNDER TABLE
H3
H3
OHO
H5
H6
4PDT 115V AC
RE4
TUBE SELECT RELAY
HF
FE
H3
SEE NOTE
FE
FE
H3
OHO
H5
EXPOSURE CIRCUIT C.F.D.-2.0
H6
BACKUP TIMER C.F.D.-6.2

NOTES: 1. ADJUST P5 FOR REQUIRED ACCELERATION TIME.
2. ALTHOUGH IT IS NOT RECOMMENDED, ROTOR RUN IN FLUORO CAN BE DEFEATED BY CONNECTING A JUMPER FROM HF TO H3 INSTEAD OF HF TO FE.

FIGURE 2-22 CFD 7.0

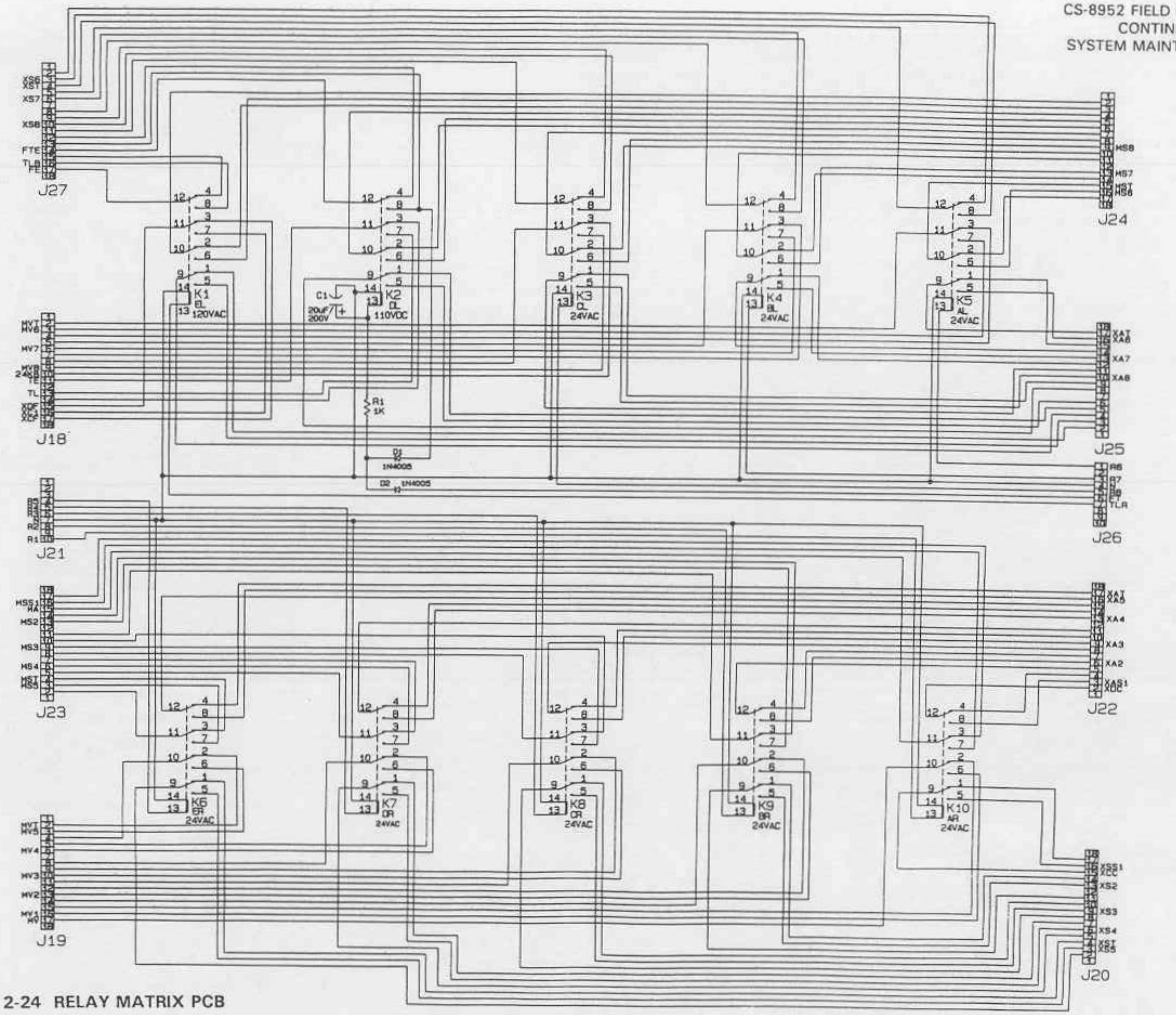

J27
XS6
XST
XS7
XS8
FTE
TLB
FE
J18
MVT
MV6
MV7
MV8
24VB
TE
TL
XOF
XC1
XCF
J21
R5
R4
R3
R2
R1
J23
MSS1
MA
MS2
MS3
MS4
MST
MS5
J19
MVT
MV5
MV4
MV3
MV2
MV1
MV
K1
EL
120VAC
K2
DL
110VDC
C1
20uF/
200V
R1
1K
D1
1N4005
D2
1N4005
K3
CL
24VAC
K4
BL
24VAC
K5
AL
24VAC
K6
ER
24VAC
K7
DR
24VAC
K8
CR
24VAC
K9
BR
24VAC
K10
AR
24VAC
J24
MS8
MS7
MST
MS6
J25
XAT
XA6
XA7
XA8
J26
R6
R7
R8
FT
TLR
J22
XAT
XA5
XA4
XA3
XA2
XAS1
XOC
J20
XSS1
XCC
XS2
XS3
XS4
XST
XS5

FIGURE 2-24 RELAY MATRIX PCB

2.23 ROTOR CONTROL CIRCUIT, CFD 7.0 (continued)

Also 230 VAC is across the rotor phase shift capacitor and exits at the closed contacts of H8/08 of Re-4 to the x-ray tube. 230 VAC from GT1 triac turns on an optocoupler OC1, allowing 24 VDC to trigger SCR1. SCR1 conducts passing 24 VDC to the emitter of the transistor Q1, switch being inhibited until the boost cycle ends.

When the 0.1 mFd timing capacitor reaches its preset charge point, as set by P1, SCR2 is triggered putting a low on the base of Q2 transistor, turning Q2 off and turning Q1 on. Relay Re-2-RC de-energizes and its contacts return to normal position with the short circuit removed from the three (3) sensors. 115 VAC on lead H3 is switched from GT1 triac to GT2 triac.

With GT2 triac turned on, 60 VAC from lead 60I is reduced to 50 VAC via the 10 ohm 100 watt slider Motor Run Adjust resistor to lead H1F, through GT2 triac and the three (3) sensing circuits, across the rotor phase shift capacitor to exit at H7/07 and H8/08 of Re-4 to the x-ray tube.

The 50 VAC now maintains the correct anode speed of about 3200 RPM.

The three (3) sensing circuits are: In Phase Current Sensor, Shifted Phase Current Sensor and Capacitor Voltage Sensor. These sensors are in series and controls the 24VDC to the "GO-NO-GO" relay Re-3 via the 2N5308 transistor.

The sensitivity of the three (3) sensors is adjusted by potentiometers P2, P3, and P4. The sensors insure adequate voltage and current is available to the stator windings of the x-ray tube for proper anode speed before an exposure is permitted. These sensors protect the x-ray tube from being damaged by exposures on a stationary target.

When any sensor is inoperative, no exposure is possible due to lack of a Rotor-to-Speed signal.

When transistor Q1 turns on, 24 VDC goes to the coil of the "GO-NO-GO" relay Re-3 but it cannot enable until the 2N5308 transistor goes into conduction. The 24 DC goes to the sensors and, if **ALL** sensors are operating, turns on the 2N5308 transistor which enables the "GO-NO-GO" relay closing contacts H3/OHO and H5/H6 going to the Exposure Circuit (CFD 2.0) on lead OHO, and to the Back-up Timer (CFD 6.2) on lead H6.

2.23 ROTOR CONTROL CIRCUIT, CFD 7.0 (continued)

This gives these two (2) circuits the necessary rotor-to-speed signal for exposure. Also the "GO" LED is illuminated.

When the PREPARE push button is released. lead H3 goes low turning off GT2 triac, 24 VDC source drops to zero (0); the "GO" relay inhibits and the rotor coasts to a stop.

In fluoro mode, the Rotor Control operates in the same manner with one exception, that being the tube select relay is enabled connecting H7/U7 and H8/U8 for the under-table tube.

2.24 SPOT FILM CHANGEOVER CIRCUIT, CFD 8.1 (FIGURE 2-23)

The changeover switch in the spot film device is a mechanically actuated switch operated by the cassette tray itself. When a spot film is commanded, the cassette tray moves forward to the in-beam position closing the contacts FE/RL.

The spot film preheat adjustment is necessary to keep the large focal spot filament in the under-table tube warm during fluoro so that when a Spot Film is called for, the boost time will not be excessively long. However, the filament cannot be hot enough for emission during fluoroscopy.

During fluoroscopy, relay Re-6-SF located on the Relay Matrix PCB (FIGURE 2-24) is energized via lead FT from the fluoroscopic timer and contacts TE/TL are closed supplying 115VAC, via lead TL to the Fluoroscopic Exposure Control (CFD 3.4) and to the Power Circuit (CFD 1.0) to energize the Fluoro Contactor.

When the fluoroscopic timer reaches zero (0) time, leads TL/FTE close and relay Re-6-SF remains closed through FTE diode, holding the contactor and a diode. The fluoro exposure continues, but the fluoro time expired buzzer sounds. When the fluoro exposure is released, relay Re-6-SF will open.

If another exposure is attempted before the fluoro timer is reset, it will be inhibited since Re-6-SF will not close. The fluoro time expired buzzer will sound to alert the operator to reset the fluoro time.

The amount of fluoro time is controlled by a five (5) minute, synchronous, motor driven timer, which normally runs whenever fluoro is active and is shut off when fluoro is inactive.

A mechanical cam, connected to the dial shaft, operates a single pole double throw switch. The switch is held by the cam in its normally opened position when the dial indicator is between 5 minutes and zero (0) time, and transfers to its normally closed position at zero (0) time. The timer stops at this point. The cam, consisting of two (2), 180 degrees segments, is both positional and angle adjustable. Since the timer uses a synchronous motor, the angular rate of motion will depend on the frequency of the existing voltage. The rate of motion at 60 Hz is 62 degrees per minute, at 50Hz 51-2/3 degrees per minute.

The panel is provided with a reversible decal, indicating the time divisions for each frequency. The zero (0) point on both sides is at the same angular position relative to the placement and the off position of the cam need not be changed. The decal facing and start cam (5 minutes) position must be adjusted for the operating frequency of the generator.

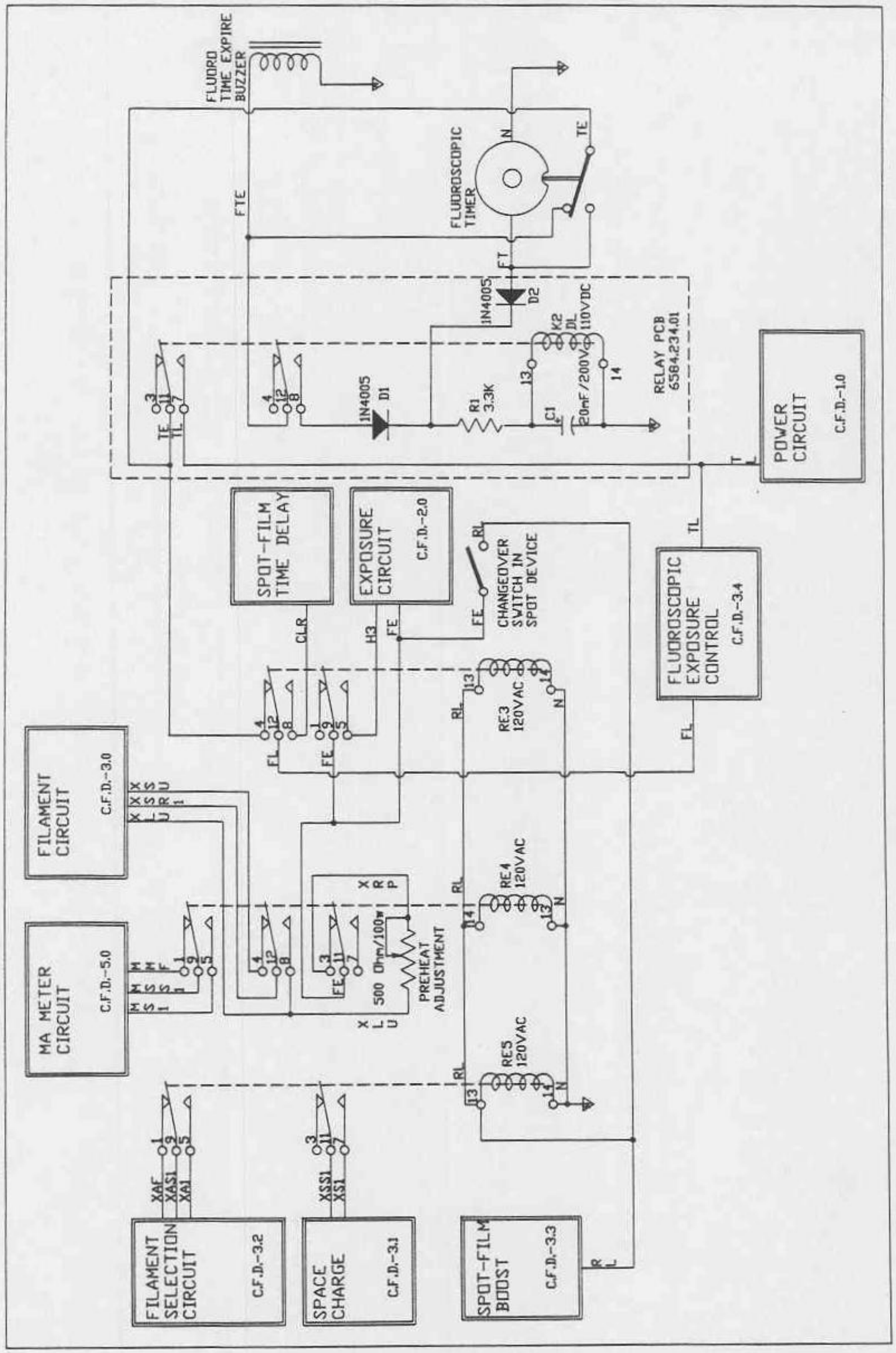

FLUORO TIME EXPIRE BUZZER
FTE
FLUOROSCOPIC TIMER
N
TE
FT
1N4005
D2
K2
DL
110VDC
RELAY PCB
6584.234.01
TE
TL
3
11
7
4
12
8
1N4005
D1
R1
3.3K
13
C1
20mF/200V
14
POWER CIRCUIT
C.F.D.-1.0
T
L
SPOT-FILM TIME DELAY
EXPOSURE CIRCUIT
C.F.D.-2.0
RL
FE
CHANGEOVER SWITCH IN SPOT DEVICE
TL
FLUOROSCOPIC EXPOSURE CONTROL
C.F.D.-3.4
CLR
H3
FE
RE3
120VAC
RL
N
FL
FILAMENT CIRCUIT
C.F.D.-3.0
XLU
XSS
XRR
XU1
MA METER CIRCUIT
C.F.D.-5.0
MS1
MS1
MF
1
9
5
500 Ohm/100w
PREHEAT ADJUSTMENT
XLU
XRP
RE4
120VAC
RE5
120VAC
XAF
XAS1
XA1
XSS1
XS1
FILAMENT SELECTION CIRCUIT
C.F.D.-3.2
SPACE CHARGE
C.F.D.-3.1
SPOT-FILM BOOST
C.F.D.-3.3
R
L

FIGURE 2-23 CFD 8.1

SEE ADJACENT FOLDOUT FOR THIS PAGE.

FIGURE 2-24 RELAY MATRIX PCB

2.24 SPOT FILM CHANGEOVER CIRCUIT, CFD 8.1 (continued)

During fluoro or at any time that the cassette tray is in the PARK position, relays RE-I-SF, RE-2-SF, RE-3-SF, RE-4-SF, and RE-5-SF are energized. On these relays are found the following normally closed contacts:

RE-1-SF:	Lead RL to two (2) open contacts.
RE-2-SF:	Lead RL to one (1) open contact and to a closed contact for coils of relays RE-5-SF, RE-4-SF and RE-3-SF.
RE-3-SF:	Lead FE to open contact and FL/TE for fluoro.
RE-4-SF:	FE/XRP for spot film preheat, XRS1/XSU for the small focal spot on the under-table tube, and MSS1/MMF for fluoro mA meter
RE-5-SF:	XSS1 to open contact, XAS1/XAF for the small filament selection on the under-table tube.

When a spot film is commanded, the cassette tray travels to the in-beam position. When it leaves the parked position, it closes the changeover switch in the spot film device. This closes leads FE/RL and applies 115 VAC via lead RL and the normally closed contact of RE-2-SF labeled RL to the coils of relays RE-3-SF, RE-4-SF and RE-5-SF causing them to energize. On these relays are found the following normally open, now closed, contacts:

Re-1-SF:	Lead RL to energize Re-2-SF relay and also to hold relays Re-5-SF, Re-4-SF, and Re-3-SF energized.
Re-2-SF:	Lead RL to self hold relay Re-2-SF energized, to one open contact, and to provide 115VAC to Filament Boost Circuit (CFD 3.3).
RE-3-SF:	FE/H3 supplies 115 VAC to Exposure Circuit (CFD 2.0), and FL/CLR supplies 115 VAC to energize RE- 1-SF relay and for exposure continuity.
Re-4-SF:	MSS1/MS1 for the selectable mA meter shunt, FE to one open contact, and XRS1/XLU for the large filament on the under-table tube.
Re-5-SF:	XSS1/XS1 and potentiometer P31 and XAS1/XA1 for filament selection.

When the radiographic exposure is initiated, relay Re-1-SF energizes closing leads RL/RLI which energizes Re-2-SF opening leads RL/RLI and closes the latching contact. Self holds Re-2-SF is energized.

After the spot film exposure has been completed, relays Re-3-SF, Re-4-SF and Re-5-SF deenergize because relay Re-1-SF deenergizes. Relay Re-2-SF remains energized until the Cassette Tray has returned to its parked position opening leads FE/RL on the changeover switch.

2.24 SPOT FILM CHANGEOVER CIRCUIT, CFD 8.1 (continued)

This sequence initiates changeover from fluoro to radiographic modes as soon as the cassette tray leaves the parked position and returns to fluoro mode as soon as the radiographic exposure has terminated. This allows the x-ray tube filament to cool off to fluoroscopic level while the cassette tray is in transit back to the park position.

2.25 AUTOTIMER DENSITY SELECTION

SEE AUTOMATIC EXPOSURE CONTROL CHAPTER.

2.26 AUTOTIMER & BACK-UP TIMER INTERLOCK

When an mA is selected by depressing an mA select push button, a relay is energized to provide information about the selected mA to various circuits within the Control. This information is used to determine exposure limits, technique factors, and density levels for the exposure and provides for safe operation of the unit.

For discussion purposes, assume the 200L mA station has been selected. The operation of the other mA stations is in the same manner with the exception of the spot film mA stations which will be described after the radiographic mA selections.

From the Light Circuit (CFD 1.3), lead R5 will be 24 VAC to N energizing the 200L mA Select relay. Normally open contacts MVD/MV5 close as shown on the mA-Time-kVp Overload (CFD 2.2). This allows the kVp Analog to set a maximum kVp for each mA station.

On the Filament Circuit (CFD 3.0), normally open contacts XD/XLO close and supply the filament transformer primary, for the large focal spot in the over-table x-ray tube, with a modified voltage for a 200 mA exposure.

On the Autotimer Technique Selector (CFD 9.4, FIGURE 2-27), normally open contacts EFO/ERO close to provide 115 VAC through the Safety Circuits.

The normally open contacts DBP/BTC between the Density Selector (CFD 9.0, FIGURE 2-25) and the Back-up Timer (CFD 6.2) close selecting a resistor in the Charge Circuit for the 600 mAs Limit capacitor.

On the Exposure Circuit (CFD 2.0), normally open 115F/FE close when a spot film mA selection is made. This opens the PREPARE and EXPOSE push button circuit on the control and allows spot film exposures to be taken from the spot film device. During a normal radiographic exposure, the exposure cannot be taken from the spot film device.

2.27 AUTOTIMER RESET AND FIELD SELECTOR, CFD 9.0 (FIGURE 2-25)

Switch assembly (part number 5184.234.041) connects to the ion chamber control unit.

From circuit breaker CB5 comes 24 VAC, on 24F, to one contact set of the Autotimer ON/OFF switch. From circuit breaker CB3 comes 115 VAC, on 115V, to the other contact set. When the switch is on, the 24F is across normally open, now closed contact to 24P. 24P energizes the 24 volt lamps in both Autotimer switches, when appropriate. 115V is across the other normally open, now closed, contact to WP.

WP is the power source for the ion chamber control unit.

If the Autotimer should fault, the Autotimer reset lamp will light. The fault may be due to either the 600 mAs limit, or because the control terminated the exposure before the ion chamber control. The ion chamber control is reset by pressing the Autotimer reset button. This puts a low (0V) from WPN to WPQ, which resets the logic of the ion control.

The field selection switches are independent latch type switches. This allows the selection of any one or any combination of the three (3) grid chamber, ion chamber fields. The spot film device ion chamber has only one (1) field, and any field selection will enable the system.

When a field selection button is depressed, it latches in the on condition. The lamp will light and the appropriate field select line, FS1, FS2 or FS3 will be pulled low, energizing its associated field select relay.

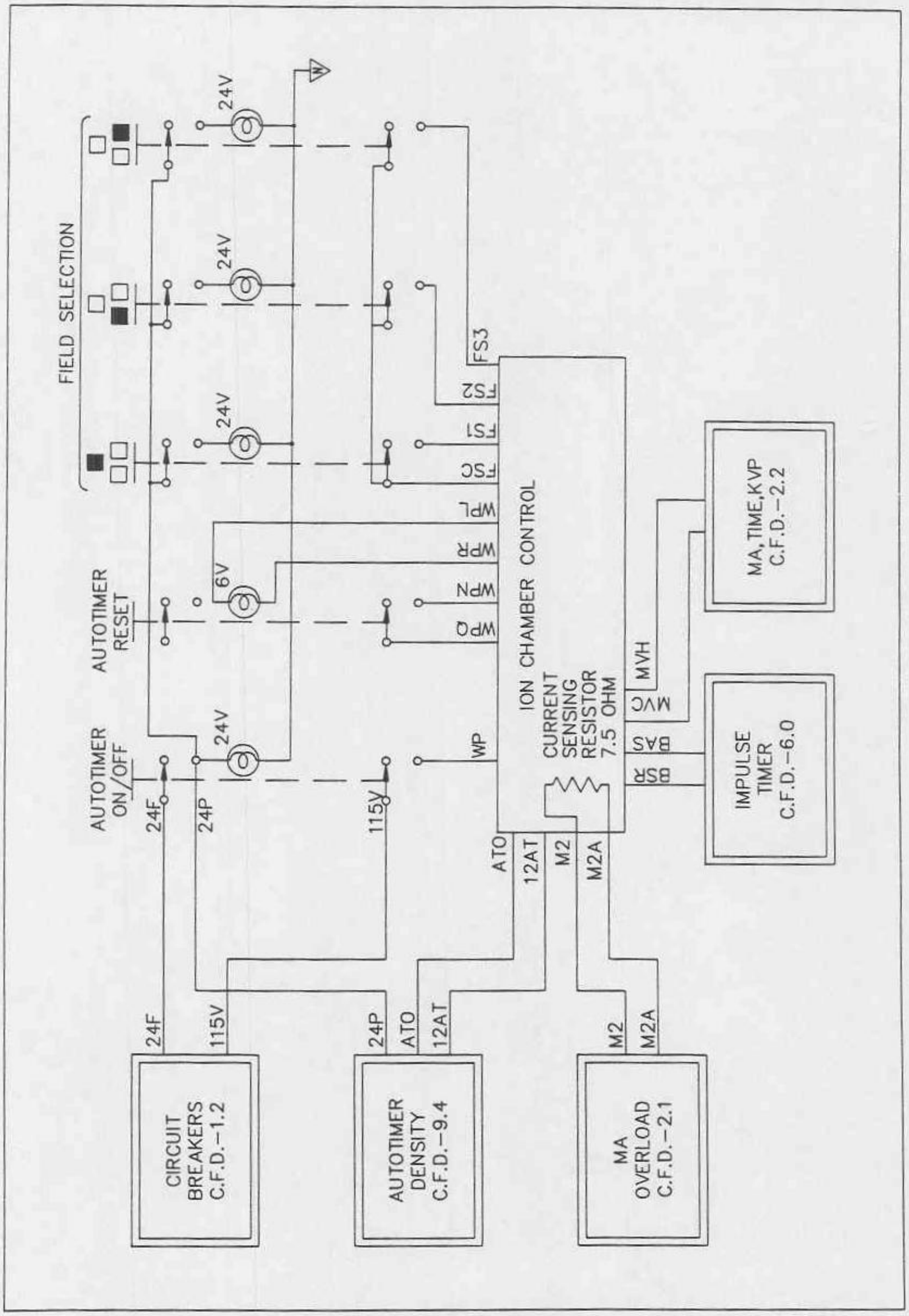

FIELD SELECTION
24V
24V
24V
AUTOTIMER RESET
6V
AUTOTIMER ON/OFF
24V
24F
24P
115V
FS3
FS2
FS1
FSC
WPL
WPR
WPN
WPO
WP
ION CHAMBER CONTROL
CURRENT SENSING RESISTOR 7.5 OHM
MVH
MVC
BAS
BSR
ATO
12AT
M2
M2A
MA,TIME,KVP C.F.D.-2.2
IMPULSE TIMER C.F.D.-6.0
24F
115V
CIRCUIT BREAKERS C.F.D.-1.2
24P
ATO
12AT
AUTOTIMER DENSITY C.F.D.-9.4
M2
M2A
MA OVERLOAD C.F.D.-2.1

FIGURE 2-25 CFD 9.0

2.28 AUXILIARY RELAY CIRCUIT, CFD 9.3 (FIGURE 2-26)

The auxiliary relay assembly allows for the selection, for each mA station, of additional control functions not available from either the mA selection switch or the mA selector relay panel. These functions are:

1. The selection of the mA time kVP adjustment pots
2. The filament drive transformer in the high voltage
3. The PREPARE/EXPOSE signal source, to control panel or Footswitch and Ion Chamber interlock
4. Damping resistor selection

On one set of contacts of each selection relay is MVD from the mA time kVP overload assembly. The relay appropriate to the mA selection, R1 for 200L SPOT, R2 for 25 mA, etc., will be energized. MVD will output on the selected MY lead back to the mA time kVp Overload assembly.

On a second set of contacts of each selection relay is XD from the Filament Control. If R1 is energized and 200L SPOT selected, XD outputs on XRS1 to the Spot Film Changeover (CFD 8.1), where the selection of XSU for the small focal spot of the under-table x-ray tube in fluoro or XLU for the large focal spot of the under-table x-ray tube in radiographic is accomplished.

Relays R2 through R4, select XSO for the small focal spot of the over-table x-ray tube. Relays R5 through R8 select XLO for the large focal spot of the over-table x-ray tube.

On the third set of contacts of R1 is 115F to either CE normally closed contact, or FE normally open contact. When R1 is off, and mA selection other than 200L SPOT is made, the PREPARE/EXPOSE enable, is to the PREPARE and EXPOSE push buttons on the control panel. When R1 is energized, and 200L SPOT is selected, the expose enable is to the Footswitch.

On the third set of contacts of R2 through is EFO safety signal. If any one of these relays is energized, connection to ERO is through the normally open contact of that relay. If none of these relays are energized, and R1 is selected, connection to ERS is through the common normally closed contacts of the relays in series. This is the ion chamber selection safety when Autotiming is selected.

On the fourth set of contacts is 24 VAC. On the auxiliary relay panel is a group of jumper connection points from the normally open contact of each relay to lead ADR. If a jumper wire is installed, ADR will be at 24 VAC when that mA station is selected. ADR operates the damper resistor shorting contactor, see (CFD 1.O).

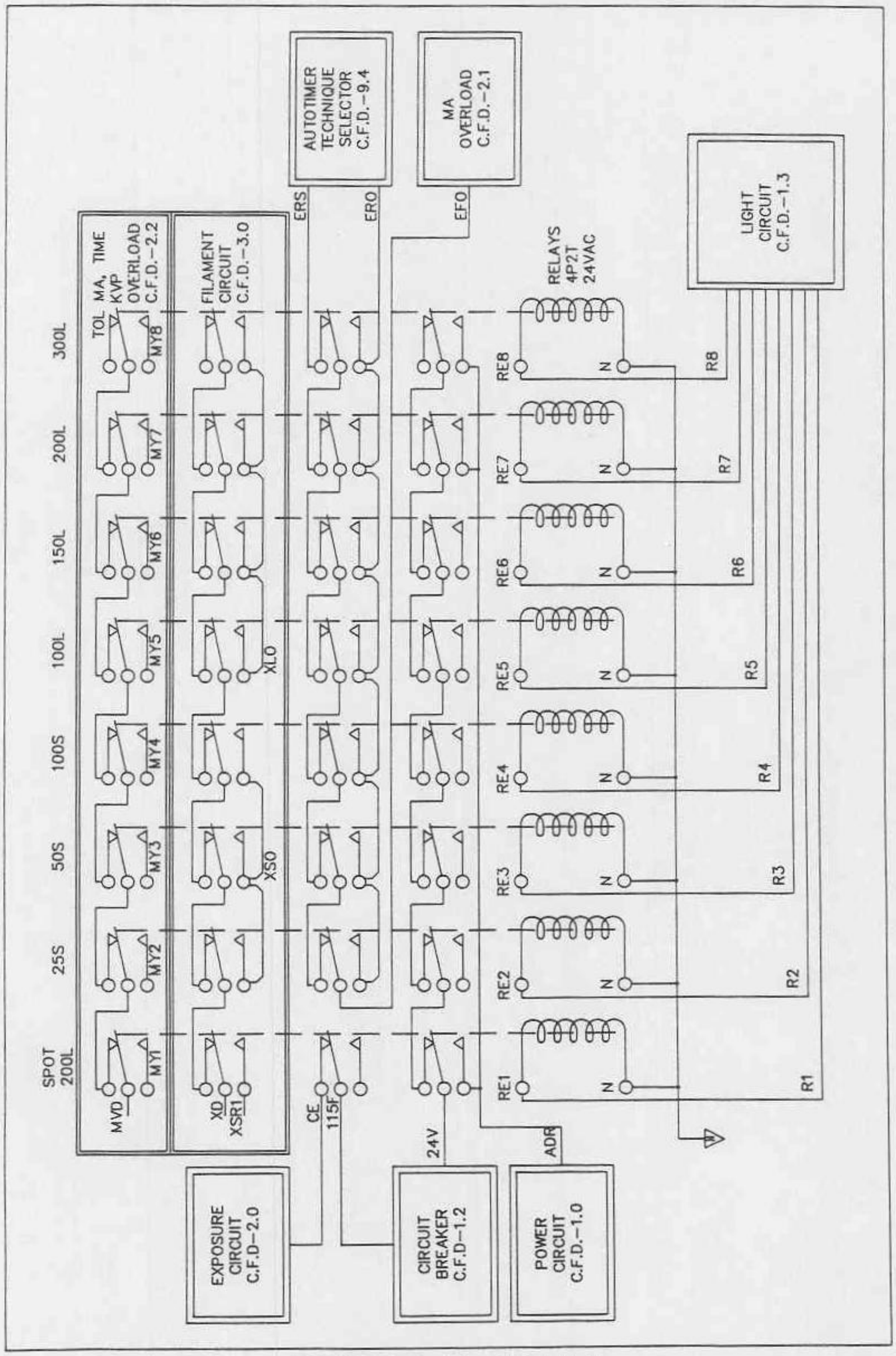

AUTOTIMER TECHNIQUE SELECTOR C.F.D.-9.4
MA OVERLOAD C.F.D.-2.1
LIGHT CIRCUIT C.F.D.-1.3
ERS
ERO
EFO
TOL MA, TIME KVP OVERLOAD C.F.D.-2.2
FILAMENT CIRCUIT C.F.D.-3.0
RELAYS 4P2T 24VAC
SPOT 200L
25S
50S
100S
100L
150L
200L
300L
MY1
MY2
MY3
MY4
MY5
MY6
MY7
MY8
MVD
XD
XSR1
XSO
XLO
CE
115F
24V
ADR
RE1
RE2
RE3
RE4
RE5
RE6
RE7
RE8
N
R1
R2
R3
R4
R5
R6
R7
R8
EXPOSURE CIRCUIT C.F.D-2.0
CIRCUIT BREAKER C.F.D-1.2
POWER CIRCUIT C.F.D.-1.0

FIGURE 2-26 CFD 9.3

2.29 AUTOTIMER TECHNIQUE SELECTOR, CFD 9.4 (FIGURE 2-27)

The chamber selection consists of two (2) interlocked switches. When either is selected, the other switch releases.

Between 12AT and ATO is 12 VDC from the ion chamber control when the Autotimer is on. Relay Re-2-AT is energized, opening normally closed contact between EFO and ERE. From the auxiliary relay panel is 115 VAC on either ERS or ERO, depending on whether a fluoro 200L SPOT or a radiographic mA station has been selected.

If 200L SPOT is selected, chamber selection push button "SPOT FILM" must be selected to provide connection from ERS to ERE for exposure enable.

If any over-table/radiographic mA is selected, chamber selector push button "BUCKY" (grid chamber), must be selected to provide connection from ERO to ERE.

Two (2) separate Autotimer density selectors are provided. One (1) on the spot film device is a rotary switch, and is operational when the 200L SPOT selection is made, and the spot film cassette has been advanced for a radiographic exposure. The other selector is located on the control panel, and is operational at all other times when the Autotimer has also been selected.

The main control panel density switches are mechanically interlocked. When any switch is pushed, it locks down and releases any other switch that was previously engaged. The lamps operate from 24P through one normally open pole of each switch.

Across the other pole of each switch, a resistor string is connected in sequence from 5070 to plus (+) 50% Density selections. Connected across the resistor string, is 12VDC between DSH and DSL. When a switch is depressed, a voltage level is generated on DSRC. The voltage levels are approximately 60 volts at minus (-) 50%, 2.7 volts at minus (-) 25%, 5.4 volts at normal, 8.1 volts at plus (+) 25% and 10.7 volt at plus (+) 50%.

The rotary Autotimer density switch on the spot film device has an identical resistor string assembly as above. The output DSW is at approximately the same voltage level as above for a similar selection.

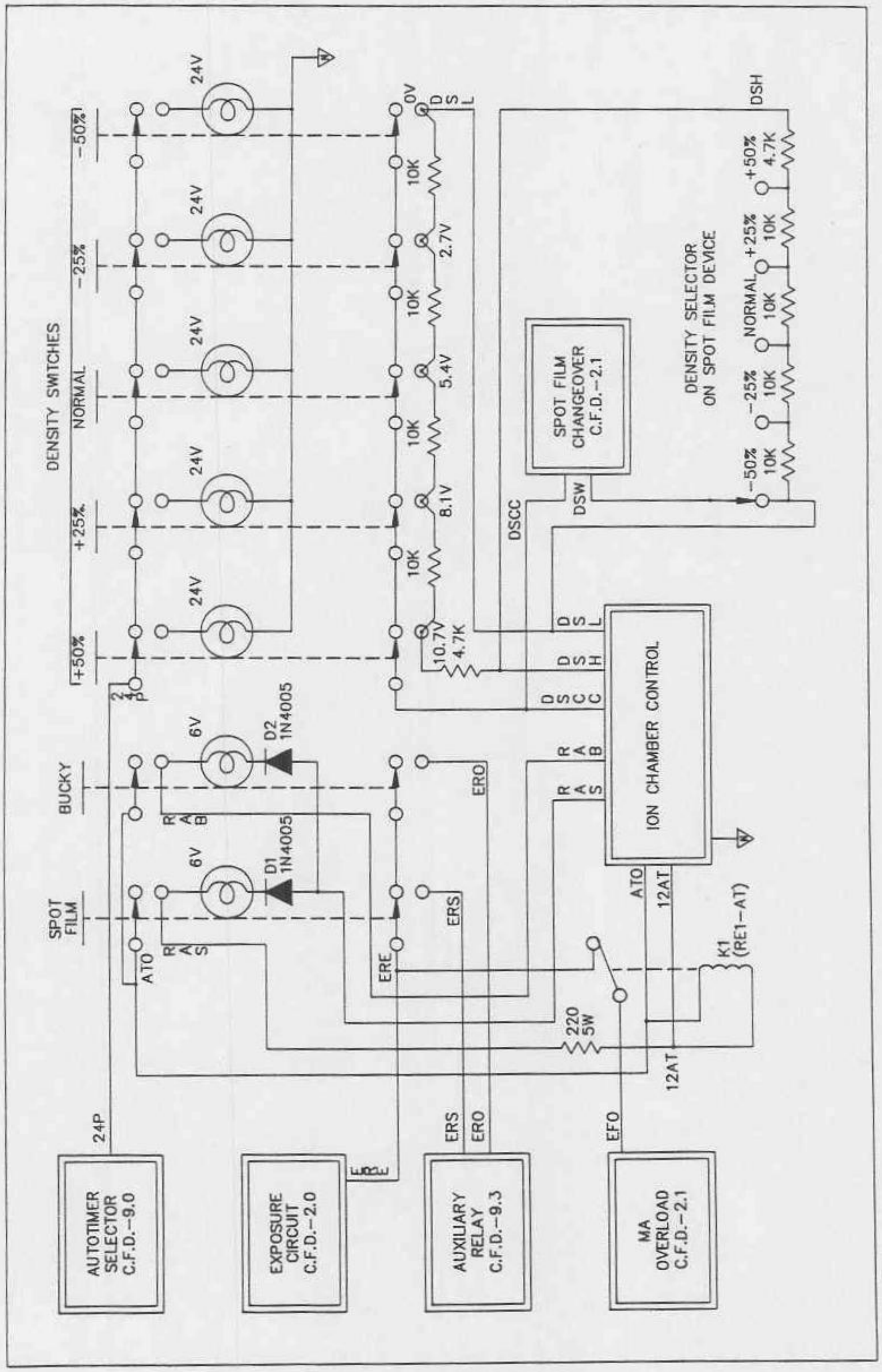

DENSITY SWITCHES
+50%
+25%
NORMAL
-25%
-50%
24V
0V
10K
10.7V
4.7K
8.1V
5.4V
2.7V
D S L
D S H
D S C C
DSCC
DSW
DSH
SPOT FILM CHANGEOVER C.F.D.-2.1
DENSITY SELECTOR ON SPOT FILM DEVICE
+50% 4.7K
+25% 10K
NORMAL 10K
-25% 10K
-50% 10K
ION CHAMBER CONTROL
R A B
R A S
ATO
12AT
K1 (RE1-AT)
220 5W
BUCKY
SPOT FILM
6V
D2 1N4005
D1 1N4005
ERO
ERS
ERE
EFO
24P
AUTOTIMER SELECTOR C.F.D.-9.0
EXPOSURE CIRCUIT C.F.D.-2.0
AUXILIARY RELAY C.F.D.-9.3
MA OVERLOAD C.F.D.-2.1

FIGURE 2-27 CFD 9.4

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SECTION 3 - MAINTENANCE

3.1 INTRODUCTION

This section is divided into two (2) main parts because MXR-350 Generator maintenance falls into two (2) basic categories: Preventive and Corrective.

Preventive maintenance consists of procedures that minimize generator failures. Component inspection, as well as operational certification and compliance tests are examples of preventive maintenance. Preventive maintenance is most effective when it is performed according to a schedule and, for this reason, it is often called Periodic maintenance.

Failures sometimes occur even when preventive maintenance is regularly performed. When this occurs, the cause of the failure must be located and repaired. This is called corrective maintenance.

3.2 PREVENTIVE (PERIODIC) MAINTENANCE

A conscientiously conducted visual inspection frequently reveals potential malfunctions before they cause equipment failure that could be dangerous.

3.2.1 LINE SET ADJUSTMENTS

WARNING

THE ADJUSTMENTS IN THIS PARAGRAPH MUST BE PERFORMED AT THE TIME OF INSTALLATION. THEY MUST ALSO BE CHECKED AT LEAST ONCE EVERY THREE (3) MONTHS.

1. Set the major and minor kVp controls fully clockwise.

2. **TURN ON THE POWER TO THE GENERATOR.**

3. Use the coarse and fine line adjust controls to position the line set meter pointer directly over the reference mark at the center of its scale.

4. Select the 25S mA push button switch. Adjust major and minor kVp rotary switches for 78 kVp. Select 1 second on the radiographic time seconds dial.

3.2.1 LINE SET ADJUSTMENTS (continued)

5. On the Constant Current Multiplex Filament Control Circuit Board (DRAWING 6284.230.1006, FIGURE 3-1), connect the negative lead of a DC voltmeter to the junction of the two (2) 250 uF capacitors and the positive lead to the left side of the 10K ohm resistor indicated as test point XD1.

6. Adjust P30 for 0 volts.

7. Without changing the mA or kVp settings, select 2 seconds. Make an exposure while reading the front panel milliampere meter. If necessary, adjust P12 and P22, for an indication of as close as possible to 25 mA.

8. Repeat step 7 for all mA stations, using the information listed in TABLE 3-1. Use 78 kVp for all settings.

mA Station	Adj. Meter with:	mA Displayed
200L	P11, 21	200mA
SPOT		
25S	P12, 22	25mA
50S	P13, 23	50mA
100S	P14, 24	100mA
100L	P15, 25	100mA
150L	P16, 26	100mA
200L	P17, 27	200mA
300L	P18, 28	300mA

TABLE 3-1 LINE SET ADJUSTMENTS

9. Select 50kVp, 200L, 2 seconds. Make an exposure while reading the front panel Milliampere meter. If necessary, adjust P31 for an indication of, as close as possible, to 200 mA.

10. Repeat step 7 for all mA stations, using the information listed in TABLE 3-11. Be sure to use 50 kVp for all settings.

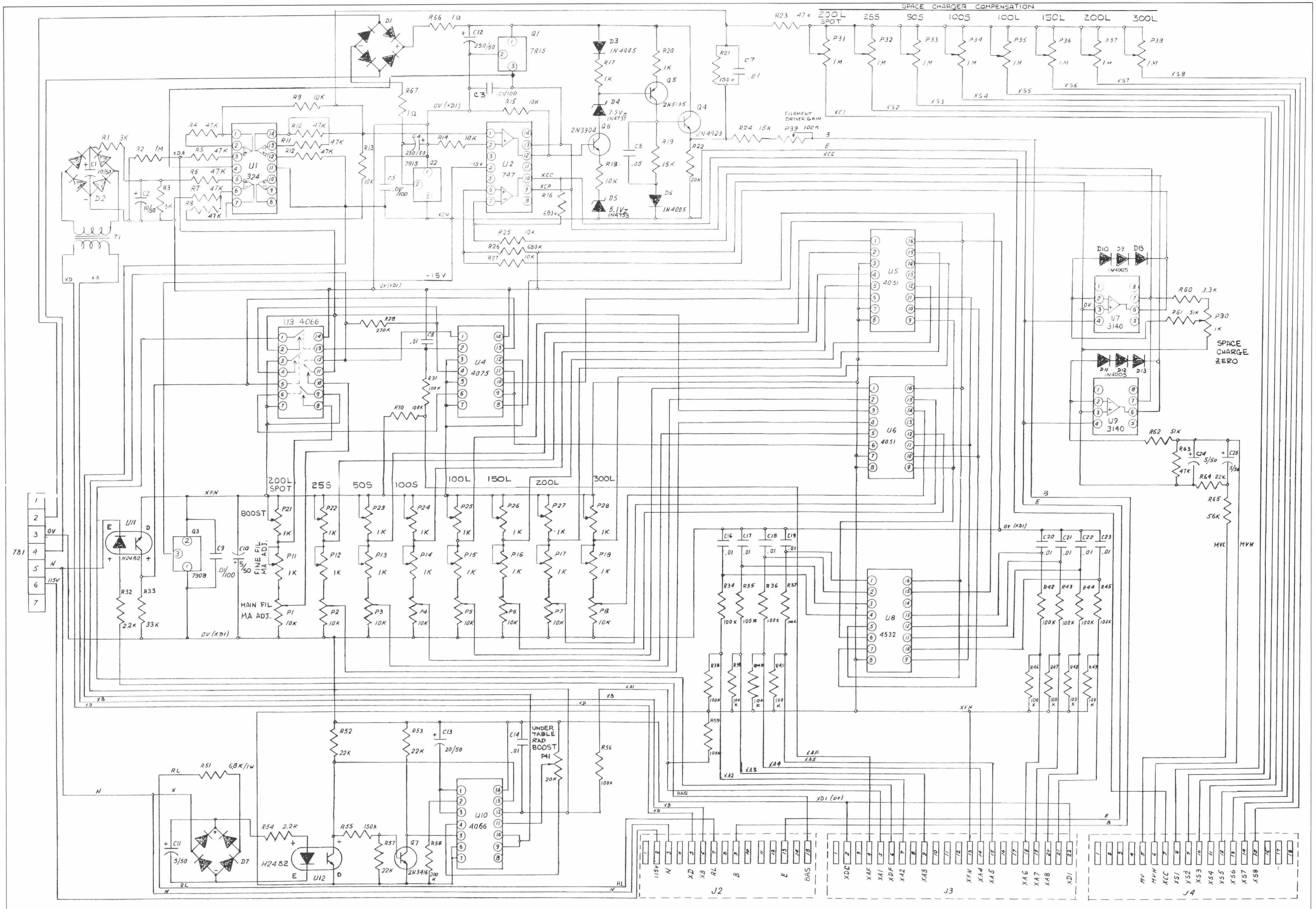
SPACE CHARGER COMPENSATION
200L SPOT
25S
50S
100S
100L
150L
200L
300L
P31
P32
P33
P34
P35
P36
P37
P38
1M
XS1
XS2
XS3
XS4
XS5
XS6
XS7
XS8
R23 47K
R21 150K
C7 .01
D1
R66 1Ω
C12 250/50
Q1 7815
C3 .01/100
R67 1Ω
D3 1N4005
R17 1K
D4 7.5Vz 1N4737
Q6 2N3904
R18 10K
D5 5.1Vz 1N4733
R20 1K
Q5 2N5195
Q4 2N4923
C5 .05
R19 15K
R22 20K
D6 1N4005
FILAMENT DRIVER GAIN
R24 15K
P39 100K
B
E
XCC
R1 3K
C1 10/50
D2
R2 1M
XDA
R3 3K
C2 10/50
T1
XD
XB
R4 47K
R5 47K
R6 47K
R7 47K
R8 47K
U1 324
R9 10K
R10 47K
R11 47K
R12 47K
R13 10K
C4 250/50
7915
Q2
C5 .01/100
XCV
0V (XDI)
R14 10K
R15 10K
-15V
U2 747
XCC
XCP
R16 680K
R25 10K
R26 680K
R27 10K
-15V
0V (XDI)
U3 4066
R28 270K
C8 .01
U4 4075
R31 100K
R30 100K
U5 4051
U6 4051
D10 D9 D8 1N4005
U7 3140
R60 3.3K
R61 51K
P30 1K
SPACE CHARGE ZERO
D11 D12 D13 1N4005
U9 3140
R62 51K
R63 47K
C24 5/50
C25 5/50
R64 22K
R65 56K
MVC
MVH
TB1
1
2
3 0V
4
5 N
6 115V
7
U11 H2482
E
D
R32 2.2K
R33 33K
Q3 7908
C9 .01/100
C10 5/50
XFN
BOOST
FINE FIL MA ADJ.
MAIN FIL MA ADJ.
P21 P22 P23 P24 P25 P26 P27 P28
P11 P12 P13 P14 P15 P16 P17 P19
P1 P2 P3 P4 P5 P6 P7 P8
1K
10K
0V (XDI)
C16 C17 C18 C19 .01
R34 R35 R36 R37 100K
R38 R39 R40 R41 100K
R59 100K
U8 4532
C20 C21 C22 C23 .01
R42 R43 R44 R45 100K
R46 R47 R48 R49 100K
XFN
XA1
XA2
XA3
XA4
XA5
XAF
BAS
XDI (0V)
R52 22K
R53 22K
C13 20/50
C14 .01
UNDER TABLE RAD BOOST P41 20K
R56 100K
U10 4066
R51 6.8K/1W
RL
N
C11 5/50
D7
R54 2.2K
H2482
U12
R55 150K
R57 22K
Q7 2N3416
R58 200K
J2
115V N XD XB RL B E BAS
J3
XDC XAF XA1 XDF XA2 XA3 XFN XA4 XA5 XA6 XA7 XA8 XDI
J4
MV MVH XCC XS1 XS2 XS3 XS4 XS5 XS6 XS7 XS8

FIGURE 3-1 CONSTANT CURRENT MULTIPLEX FILAMENT CONTROL CIRCUIT BOARD (DRAWING 6284.230.1006)

SEE ADJACENT FOLDOUT FOR THIS PAGE.

FIGURE 3-1 CONSTANT CURRENT MULTIPLEX FILAMENT CONTROL CIRCUIT BOARD (DRAWING 6284.230.1006)

3.2.2 NINETY (90) DAY INSPECTION

It is recommended that the procedure in this subparagraph be performed at least once every ninety (90) days.

WITH THE POWER TURNED OFF AT THE MAIN DISCONNECT SWITCH:

If necessary, clean the exteriors of main control and high voltage transformer of dust and spills.

Instruct operators on the importance of equipment cleanliness. Spillage of any liquid on the generator can cause a malfunction, particularly if it finds its way into the interior. This is especially so with liquids that leave a solid residue after they dry. It is important to promptly remove spills with a soft cloth dampened in warm water. Regular cleaning can also be accomplished with a soft cloth, warm water, and a mild detergent.

Inspect all electrical cables, cords, connectors, and fittings for tightness. Check for breaks in the insulation, abrasions, and other damage to cables and connectors. Pay particular attention to areas where electrical cabling enters housings or it may be subject to stress from mechanical motions.

Thoroughly inspect all high voltage cables and their connections to the x-ray tubes and high voltage transformer.

Make sure that the connections are firmly seated and that there are no signs of arcing.

Examine the high voltage transformer for indications of oil leakage. Any indication of oil leakage requires immediate corrective action.

Examine all exterior painted or plated surfaces for evidence of deterioration, such as scratches, chipping, and corrosion. Make sure that all name plates and warning labels are present, legible and securely mounted.

WITH THE POWER TURNED ON:

Test all front panel controls and the meters for correct operation and to ensure that they light properly. Replace any burnt out lamps.

If necessary, open the apertures of both collimators and use an inspection mirror to check the filaments of the x-ray tubes to ensure that they are lit.

Do not look directly into either tube port.

3.2.3 TWELVE (12) MONTH INSPECTION.

Perform the ninety (90) day inspection in subparagraph 3.2.2.

TURN OFF THE POWER TO THE GENERATOR AT THE MAIN DISCONNECT SWITCH.

Disconnect the high voltage cables from the high voltage transformer and x-ray tubes. **Inspect them thoroughly and replace as required.**

Clean the terminations and repack the x-ray tube ends with Dow Corning No.4 vapor proofing compound and the transformer ends with Shell Diala AX, or equivalent, dielectric oil until it spills over. Re-install the cables.

Check the oil level in the high voltage transformer. If necessary, add Shell Diala AX, or equivalent, dialectic oil to within 1" (25.4mm) of the top cover.

3.2.4 OPERATIONAL TESTS

IT IS RECOMMENDED THAT THE TESTS IN THIS SUBPARAGRAPH BE PERFORMED NO LESS THAN ONCE EVERY NINETY (90) DAYS.

WARNING

THE PROCEDURE IN THIS SUBPARAGRAPH REQUIRES THE MAKING OF EXPOSURES. TAKE ALL PRECAUTIONS NECESSARY TO PROTECT ALL PERSONNEL AGAINST UNNECESSARY RADIATION.

Apply power to the generator by pressing the MAINS push button switch.

Refer to Circuit Description Section of this chapter, as needed, and operate each system function at least once to ensure that it operates.

Select x-ray over-table tube. Make four (4) exposures at 80 kVp, 200 mA, 0.1 seconds and at 20 second intervals.

Make four (4) additional exposures at 20 intervals, increasing the kVp by 10 KV for each exposure.

Take action to correct deficiencies that may have been found.

3.3 CORRECTIVE MAINTENANCE

3.3.1 GENERAL

When x-ray system failures occur, they must be corrected. Correcting malfunctions, often makes it necessary to remove generator parts or assemblies in order to gain access to the faulty component(s). The information in this subparagraph assists maintenance personnel in the correction of malfunctions by providing instructions for the replacement of parts.

3.3.2 HAND TOOLS REQUIRED

Slotted screwdrivers
No.l and No.2 phillips screwdrivers
Needle nosed pliers
Set of SAE open/box end wrenches OR
6" (150 mm) adjustable wrench
Inspection mirror
Wiring labels

3.3.3 TEST EQUIPMENT

Digital multimeter
Dual-trace oscilloscope
High tension tank (150 kVp) with digital readout
Radiation output meter
Assorted radiation phantoms

3.3.4 PARTS REPLACEMENT

- HIGH VOLTAGE RECTIFIER REPLACEMENT

WARNING

THE HIGH VOLTAGE RECTIFIERS ARE LOCATED INSIDE THE HIGH VOLTAGE TRANSFORMER WHERE EXTREMELY DANGEROUS VOLTAGES ARE PRODUCED DURING SYSTEM OPERATION. IT IS VITAL TO ENSURE THAT ALL PERSONNEL IN THE AREA OF THE GENERATOR ARE AWARE THAT MAINTENANCE OF THE HIGH VOLTAGE CIRCUITRY IS IN PROGRESS.

NOTE

It is recommended that the procedure in this subparagraph be performed by, or under the supervision of, an experienced biomedical equipment maintenance technician.

Make sure that the power to the generator is locked in the **OFF** position at the system main disconnect switch.

TAG THE SWITCH TO NOTIFY ALL PERSONNEL THAT MAINTENANCE IS IN PROGRESS.

Disconnect all cables from the auxiliary cabinet and remove the four (4) screws holding the cabinet on the top of the transformer. Lift the cabinet from the transformer.

Disconnect the three (3) prong power plug from the top of the high voltage transformer. **Do not disconnect the twelve (12) pin auxiliary plug.**

WARNING

LABEL AND DISCONNECT ALL FOUR (4) X-RAY TUBE HIGH VOLTAGE CABLES FROM THE TRANSFORMER. THESE CABLES OFTEN STORE A POTENTIALLY FATAL ELECTRICAL CHARGE. USE A SHORTING BAR OR OTHER SIMILAR DEVICE TO DISCHARGE EACH CABLE AS IT IS DISCONNECTED.

3.3.4 PARTS REPLACEMENT (continued)

CAUTION

THE HIGH VOLTAGE TRANSFORMER HOUSING IS FILLED WITH HIGHLY PURIFIED DIELECTRIC OIL. IMPURITIES IN THIS OIL ARE CAPABLE OF CAUSING DAMAGE TO TRANSFORMER COMPONENTS WHEN POWER IS APPLIED.

WHILE IT IS NOT NECESSARY TO DRAIN THE OIL FROM THE TRANSFORMER TO REPLACE THE HIGH VOLTAGE RECTIFIERS, IT IS IMPORTANT TO MAINTAIN ITS PURITY DURING THE PROCEDURE. THIS INCLUDES NOT ONLY ENSURING THAT IMPURITIES DO NOT ENTER THE HOUSING INTERIOR, BUT THAT HANDS AND ARMS ARE FREE OF DIRT AND PERSPIRATION BEFORE PERFORMING THE STEPS THAT FOLLOW.

Thoroughly clean the top of the high voltage transformer housing.

Carefully remove the access cover from the top of the high voltage transformer housing. This cover is fitted with a cork gasket that may have become brittle with age, adhere to the access cover, transformer housing, or both. Use caution to ensure that screws, small pieces of cork, or dirt do not fall into the dielectric oil in the transformer housing.

CAUTION

ALWAYS SCRAPE AWAY FROM THE ACCESS PORT AND SCREW HOLES IF SCRAPING IS NEEDED TO REMOVE REMNANTS OF THE GASKET FROM THE TRANSFORMER HOUSING,

Be sure that hands and arms are free of dirt and perspiration.

The high voltage rectifiers are vertically mounted on plug-in strips on the side of the access port closest to the power plug. Each of these strips is fitted with a banana plug on one end and a banana receptacle on the other. They can only be installed correctly.

CAUTION

THE HIGH VOLTAGE RECTIFIER STRIPS MUST BE REPLACED AS A SET, FAILURE IN ONE WILL DAMAGE ALL OTHERS.

3.3.4 PARTS REPLACEMENT (continued)

After the high voltage rectifier strips have been replaced, re-install the access cover and restore the transformer to operation by following this procedure in reverse. It is recommended that the cork access cover gasket be replaced each time that the cover is removed.

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SECTION 4 - MX-350 GENERATOR SIGNALS DESCRIPTION

NOTE

For information detailing "source" and "destination" of these signals, see Chapter 4, Section 2.2

115F-	115VAC FUSED (USED FOR EXPOSURE)
115I-	115VAC ISOLATED (FROM AUXILIARY POWER TRANSFORMER)
115S-	115VAC STABILIZED (FROM CONSTANT VOLTAGE TRANSFORMER)
115V-	115VAC FUSED (FROM "115I" AT 15 AMPS)
12AT-	12VDC (FROM AID CONTROL)
15C-	115VAC FOR OVER TABLE COLLIMATOR (PRESENT WHEN OVER TABLE mA STATION SELECTED)
15IT-	115VAC FOR IMPULSE TRANSFORMER
15MS-	115VAC FOR MAS CIRCUIT
230I-	230VAC ISOLATED (FROM AUXILIARY POWER TRANSFORMER)
230V-	230VAC FUSED
24BT-	24VAC FOR BACK-UP TIMER
24I-	24VAC ISOLATED (FROM AUXILIARY POWER TRANSFORMER)
24KA-	24VAC ISOLATED FOR KVP COMPENSATION
24KB-	24VAC ISOLATED FOR KVP COMPENSATION
24P-	24VAC FOR LAMPS OF AUTOTIMER SELECTOR SWITCHES
24V-	24VAC
3D-	24VDC FROM BACK-UP TIMER TO BACK-UP TIMER RESISTOR DECK
60I-	60VAC ISOLATED (FROM AUXILIARY POWER TRANSFORMER)
60V-	60VAC TO ROTOR RUN RESISTOR FOR ROTOR RUN VOLTAGE
A1-	VOLTAGE TAPS FROM POWER AUTO TRANSFORMER
A2-	SAME AS ABOVE
A3-	SAME AS ABOVE
A4-	SAME AS ABOVE
A5-	SAME AS ABOVE

MXR-350 GENERATOR SIGNALS DESCRIPTION (continued)

A6-	VOLTAGE TAPS FROM POWER AUTO TRANSFORMER
A7-	SAME AS ABOVE
A8-	SAME AS ABOVE
A9-	SAME AS ABOVE
A10-	SAME AS ABOVE
A11-	SAME AS ABOVE
A12-	SAME AS ABOVE
A13-	SAME AS ABOVE
A14-	SAME AS ABOVE
A15-	SAME AS ABOVE
A16-	SAME AS ABOVE
A17-	SAME AS ABOVE
A18-	SAME AS ABOVE
A20-	SAME AS ABOVE
AC-	COMMON OF MAJOR KVP SELECTOR SWITCH
ACF-	"AC" (ABOVE) FUSED
ACKM-	"AC" (ABOVE) TO KVP METER TRANSFORMER
ACM-	TAP ON RADIOGRAPHIC DAMPING RESISTOR
ACR-	LEAD FROM DAMPING RESISTOR TO RADIOGRAPHIC CONTACTOR
ADR-	ACTIVATING VOLTAGE FOR DAMPING RESISTOR CONTACTOR AT 24VAC
AF-	OUTPUT FROM FLUORO KVP VARIAC
AH-	FROM MAJOR KVP TAP SWITCH TO FLUORO VARIAC/HIGH FLUORO VOLTAGE
AL-	FROM MAJOR KVP TAP SWITCH TO FLUORO VARIAC/LOW FLUORO VOLTAGE
AM-	COMMON OF MINOR KVP TAP SWITCH (TO POWER SELECTION OF IMPULSE TRANSFORMER)
AMF-	"AM" (ABOVE) FUSED
AMR-	POWER LEAD OUTPUT OF IMPULSE TIMER (TIME CONTROLLED VOLTAGE)
AMW-	"AM" (ABOVE) TO KVP METER TRANSFORMER

MXR-350 GENERATOR SIGNALS DESCRIPTION (continued)

AQF-	FLUORO EXPOSURE POWER VOLTAGE (AFTER DAMPING RESISTOR TO FLUORO KVP METER)
ATO-	AUTOTIMER ZERO FROM AUTOTIMER CONTROL (RETURN FOR "12AT" ABOVE)
AUX-	AUXILIARY VOLTAGE (SELECTED BY AUX. SWITCH OF FUNCTION SWITCH ASSEMBLY) AT 115VAC
B-	BASE DRIVE FOR FILAMENT CONTROL ASSEMBLY (CHIMNEY)
B1A-	TABLE BUCKY EXPOSURE SIGNAL - NOT USED
B1B-	WALL CASSETTE BUCKY EXPOSURE SIGNAL - NOT USED
B2-	BUCKY/GRID CHAMBER EXPOSE SIGNAL OUTPUT
BAC-	20VDC FROM IMPULSE TIMER (WHEN EXPOSURE ACTIVATED: ON WHEN "H6T" ON)
BAL-	EXPOSE LAMP DRIVE (ON DURING EXPOSURE ON TIME)
BAM-	20VDC SAME AS "BAC" (JUMPER CONNECTED)
BAP-	20VDC (ON DURING EXPOSURE ON TIME)
BAS-	20VDC (ON DURING EXPOSURE ON TIME)
BCE-	CONTINUATION OF "B2" THROUGH EXPOSURE SAFETY RELAY
BE-	CONTINUATION OF "CL" WHEN OVER TABLE mA STATION SELECTED (INPUT TO BUCKY/GRID CHAMBER SELECT SWITCHES)
BPL-	BACK-UP CONTACTOR ACTIVATION SIGNAL AT 115VAC
BPT-	115VAC (WHEN BACK-UP TIMER TERMINATES)
BSR-	EXPOSURE STOP SIGNAL FROM AUTOTIMER (ACTIVE LOW)
BUC-	BACK-UP CONTACTOR ACTIVATION SIGNAL
BUQ-	BACK-UP TIMER LATCH DOWN (OPERATES LATCH OFF RELAY OF BACK-UP TIMER) AT 115VAC
C1-	MAIN SWITCH TO MAIN RELAY ON THE ROTOR CONTROL BOARD
CE-	INPUT TO PREP SWITCH
CL-	OUTPUT FROM EXPOSE SWITCH
CL1-	CONTINUATION OF "L1" FROM MAIN SWITCH
CLR-	RADIOGRAPHIC UNDER TABLE EXPOSURE SIGNAL
CM-	LINE CONTACTOR COIL SIGNAL
CN-	LINE CONTACTOR COIL SIGNAL
D2T-	TIME SELECT RESISTOR RETURN (IMPULSE TIMER)

MXR-350 GENERATOR SIGNALS DESCRIPTION (continued)

DBR-	BACK-UP TIMER RESISTOR DECK RETURN TO BACK-UP TIMER BOARD
DSC-	AUTOTIMER DENSITY SELECT INPUT TO AUTOTIMER CONTROL
DSCC-	CONTROL AUTOTIMER DENSITY SELECTION
DSCS-	SPOT FILM DEVICE AUTOTIMER DENSITY SELECTION
DSH-	12VDC AUTOTIMER DENSITY (HIGH); SELECT INPUT "12AT"
DSL-	AUTOTIMER DENSITY (LOW); SELECT INPUT "ATO"
E-	EMITTER CONNECTION TO FILAMENT DRIVE ASSEMBLY
EFO-	OUTPUT FROM CONTACT OF mA OVERLOAD RELAY (NC)
ER-	INPUT TO CONTACT OF mA OVERLOAD RELAY (C)
ERE-	SAFETY RELAY COIL SIGNAL
ERO-	OVER-TABLE SELECTION SAFETY SIGNAL CONTINUATION 115VAC
ERR-	115VAC OUTPUT FROM MA,TIME, KVP (TOLA) SAFETY RELAY SIGNAL START
ERS-	SPOT FILM SELECTION SAFETY SIGNAL CONTINUATION 115VAC(ACTIVE WHEN AUTOTIMER ON)
ERX-	TIME SELECT SWITCH SAFETY SIGNAL CONTINUATION (115VAC - VALID TIME SELECTION)
ES-	SAFETY RESET LAMP DRIVE AT 24VAC
FE-	UNDER TABLE EXPOSURE AND SELECTION SIGNAL AT 115VAC
FL-	UNDER TABLE EXPOSURE SIGNAL (ACTIVE WHEN SPOT FILM DEVICE EXPOSE OR FOOTSWITCH ACTIVATED AT 115VAC)
FS1-	AUTOTIMER FIELD 1 SELECTION (ACTIVE LOW)
FS2-	AUTOTIMER FIELD 2 SELECTION (ACTIVE LOW)
FS3-	AUTOTIMER FIELD 3 SELECTION (ACTIVE LOW) (ACTIVE LOW WHEN AUTOTIMER ON)
FSC-	AUTOTIMER
FT-	FLUORO TIMER DRIVE
FTE-	FLUORO TIME EXPIRED (ON WHEN FLUORO TIME IS AT ZERO)
G-	GROUND
H1F-	50VAC ROTOR DRIVE INPUT
H2F-	230VAC ROTOR DRIVE INPUT
H3-	ROTOR START SIGNAL RADIOGRAPHIC (115VAC)

MXR-350 GENERATOR SIGNALS DESCRIPTION (continued)

H5-	EXPOSURE SIGNAL INPUT TO ROTOR SAFETY
H6-	EXPOSURE SIGNAL OUTPUT FROM ROTOR SAFETY
H6T-	IMPULSE TIMER START SIGNAL (115VAC)
H7A-	INPUT TO ROTOR PHASE SHIFT CAPACITOR (CONNECTS DIRECTLY TO "H7")
H8-	ROTOR PHASE SHIFT VOLTAGE (FROM PHASE SHIFT CAPACITOR)
HF-	ROTOR START SIGNAL UNDER TABLE
KVM-	RADIOGRAPHIC KVP METER CONNECTION
KWH-	HIGH LEVEL DC VOLTAGE FROM TOLA BOARD TO TOLA TIME SWITCH
KWL-	LOW LEVEL DC VOLTAGE FROM TOLA BOARD TO TOLA TIME SWITCH
L1-	LINE 1 POWER INPUT
L1F-	LINE 1 FUSED (FROM "L1P" AFTER CIRCUIT BREAKER)
L1P-	LINE 1 CONNECTION BETWEEN FUSE AND CIRCUIT BREAKER
L2-	LINE 2 POWER INPUT
L2F-	LINE 2 FUSED (FROM "L2P" AFTER CIRCUIT BREAKER)
L2P-	LINE 2 CONNECTION BETWEEN FUSE AND CIRCUIT BREAKER
LCH-	POSITIVE (+) LINE COMPENSATION METER LEAD
LCL-	NEGATIVE (-) LINE COMPENSATION METER LEAD
M-	mA METER INPUT
M1-	X-RAY TUBE CURRENT FROM H.V. TRANSFORMER CATHODE BRIDGE RECTIFIER ASSEMBLY
M1A-	CONTINUATION OF M1 AFTER M1 MAS METER OVERLOAD
M2-	X-RAY TUBE CURRENT FROM H.V.TRANSFORMER ANODE BRIDGE RECTIFIER ASSEMBLY
M2A-	CONTINUATION OF M2 AFTER AUTOTIMER CURRENT SENSOR
MA-	M1 CONTINUATION AFTER MAS METER CURRENT SENSOR (INPUT TO MA METER SHUNT SELECTION)
MM-	MAS SIGNAL FROM MAS CIRCUIT TO MAS METER
MMF-	TO FLUORO mA METER SHUNT
MRY-	HIGH OUTPUT FROM KVP COMPENSATION ASSEMBLY
MS1-	MA METER SHUNT SELECTION MA STATION 1
MS2-	MA METER SHUNT SELECTION MA STATION 2
MS3-	MA METER SHUNT SELECTION MA STATION 3

MXR-350 GENERATOR SIGNALS DESCRIPTION (continued)

MS4-	MA METER SHUNT SELECTION MA STATION 4
MS5-	MA METER SHUNT SELECTION MA STATION 5
MS6-	MA METER SHUNT SELECTION MA STATION 6
MS7-	MA METER SHUNT SELECTION MA STATION 7
MS8-	MA METER SHUNT SELECTION MA STATION 8
MSR1-	MAS SELECTOR BUTTON TO MAS SELECT RELAY (115VAC)
MSS1-	MA METER SHUNT SELECTION FOR FLUORO/SPOT SELECTION
MST-	METER SHUNT TRANSFER WIRE
MV-	KVP COMP COMMON (CONNECTS TO MV*)
MV1-	KVP COMPENSATION SELECTION STATION 1
MV2-	KVP COMPENSATION SELECTION STATION 2
MV3-	KVP COMPENSATION SELECTION STATION 3
MV4-	KVP COMPENSATION SELECTION STATION 4
MV5-	KVP COMPENSATION SELECTION STATION 5
MV6-	KVP COMPENSATION SELECTION STATION 6
MV7-	KVP COMPENSATION SELECTION STATION 7
MV8-	KVP COMPENSATION SELECTION STATION 8
MVD-	INPUT FROM TOLA BOARD TO MA SELECT RELAYS
MVH-	SPACE CHARGE AND AUTOTIMER HIGH SIGNAL (PROPORTIONAL TO KVP)
MVT-	KVP SELECT TRANSFER
MY1-	CONNECTION FROM MA SELECT RELAYS SELECT ADJUSTMENT POTENTIOMETERS ON TOLA BOARD mA STATION 1 SELECTED OUTPUTS AT "KWH AND "KWL"
MY2-	SAME AS ABOVE STATION 2
MY3-	SAME AS ABOVE STATION 3
MY4-	SAME AS ABOVE STATION 4
MY5-	SAME AS ABOVE STATION 5
MY6-	SAME AS ABOVE STATION 6
MY7-	SAME AS ABOVE STATION 7
MY8-	SAME AS ABOVE STATION 8
N-	NEUTRAL (CONTROL ((AUXILIARY)) POWER RETURN)

MXR-350 GENERATOR SIGNALS DESCRIPTION (continued)

07-	OVER-TABLE ROTOR IN-PHASE VOLTAGE
08-	OVER-TABLE ROTOR PHASE SHIFT VOLTAGE
OHO-	ROTOR SAFETY (CONNECTS FROM "H3" WHEN ROTOR IN RUN AND GO)
P1-	POWER CONNECTION TO H.V. TRANSFORMER
P2-	POWER OUTPUT TO H.V.TRANSFORMER
QF-	FLUORO POWER CONNECTION (CONTINUATION FROM "AF")
QU-	H.V. UNBALANCE SAFETY SIGNAL
R1-	MA SELECT RELAY ACTIVATION SIGNAL AT 24VAC mA STATION 1
R2-	SAME AS ABOVE STATION 2
R3-	SAME AS ABOVE STATION 3
R4-	SAME AS ABOVE STATION 4
R5-	SAME AS ABOVE STATION 5
R6-	SAME AS ABOVE STATION 6
R7-	SAME AS ABOVE STATION 7
R8-	SAME AS ABOVE STATION 8
RAB-	AUTOTIMER CHAMBER SELECT RELAY (BUCKY/GRID CHAMBER) ACTIVE LOW
RAS-	SPOT FILM AUTO CHAMBER SELECT RELAY
RL-	UNDER TABLE RAD SELECTED (FROM SPOT FILM DEVICE)
SO-	OVER TABLE SELECTION OF H.V. (OPERATES CHANGE OVER SWITCH IN H.V.TRANSFORMER)
SR1-	DRIVE SIGNAL TO FILAMENT CONTROL TRANSFORMER SECONDARY
SR2-	SAME AS ABOVE
SU-	UNDER TABLE SELECTION OF H.V. (OPERATES CHANGE OVER SWITCH IN H.V.TRANSFORMER)
T1-	POWER OUTPUT FROM CONTACTS OF MAIN CONTACTOR
T1A-	INPUT TO AUXILIARY POWER TRANSFORMER
T2-	POWER OUTPUT FROM CONTACTS OF MAIN CONTACTOR
T2L-	OTHER INPUT TO AUXILIARY POWER TRANSFORMER
TE-	FLUORO EXPOSE OUTPUT FROM CHANGE OVER (CONTINUATION OF"FL" IN FLUORO - 115VAC)
TL-	FLUORO CONTACTOR ACTIVATION SIGNAL (115VAC)

MXR-350 GENERATOR SIGNALS DESCRIPTION (continued)

TLB-	ACTIVATES HIGH LEVEL FLUORO SIGNAL
TLH-	HIGH LEVEL FLUORO SIGNAL FROM FOOTSWITCH
TLR-	ACTIVATES HIGH LEVEL FLUORO SELECT RELAY
TOL-	MA, TIME, KVP OVERLOAD SIGNAL
TRI-	IMPULSE TIMER RESISTOR DECK RETURN
U7-	UNDER TABLE IN-PHASE ROTOR VOLTAGE
U8-	UNDER TABLE PHASE SHIFTED ROTOR VOLTAGE
UF-	FLUORO POWER CONNECTION FROM POWER AUTO TRANSFORMER
UFF-	POWER LEAD FROM FLUORO CONTACTOR TO RAD/FLUORO CHANGE OVER CONTACTOR
WP-	115VAC TO AUTO TRANSFORMER (AUTOTIMER POWER INPUT)
WPN-	AUTOTIMER RESET SWITCH RETURN ("ATO")
WPL-	ACTIVATION SIGNAL FOR AUTOTIMER RESET LAMP (ACTIVE LOW)
WPO-	5VDC FROM AUTOTIMER TO LAMP IN RESET BUTTON
WPR-	AUTOTIMER RESET (AUTOTIMER RESET SWITCH)
XA1-	FILAMENT SELECTION SIGNAL TO FILAMENT CONTROL BOARD MA STATION 1
XA2-	SAME AS ABOVE MA STATION 2
XA3-	SAME AS ABOVE MA STATION 3
XA4-	SAME AS ABOVE MA STATION 4
XA5-	SAME AS ABOVE MA STATION 5
XA6-	SAME AS ABOVE MA STATION 6
XA7-	SAME AS ABOVE MA STATION 7
XA8-	SAME AS ABOVE MA STATION 8
XAF-	FLUORO FILAMENT SELECT
XAS1-	SPOT/FLUORO FILAMENT SELECT (BECOMES EITHER "XAF" OR "XA1")
XAT-	FILAMENT SELECT TRANSFER
XB-	OUTPUT OF FILAMENT CONTROL TRANSFORMER, INPUT TO CURRENT SENSE TRANSFORMER ON FILAMENT CONTROL BOARD
XBR-	FILAMENT BOOST SHUNT RESISTOR DRIVE
XC1-	HIGH LEVEL FLUORO FILAMENT ADJUST VOLTAGE
XCC-	SPACE CHARGE DRIVE VOLTAGE

MXR-350 GENERATOR SIGNALS DESCRIPTION (continued)

XCF-	LOW LEVEL FLUORO FILAMENT ADJUST VOLTAGE
XCN-	8 VOLTS TO FLUORO FILAMENT ADJUST BOARD
XD-	OUTPUT AFTER CURRENT SENSE TRANSFORMER, INPUT TO FILAMENT
XD1-	0 VOLTS CONNECTION OF FILAMENT CONTROL BOARD (INTERNAL CONNECTION ON CIRCUIT BOARD)
XDC-	SAME AS ABOVE
XDF-	FLUORO FILAMENT ADJUST INPUT TO FILAMENT CONTROL
XLO-	FILAMENT DRIVE TO LARGE OVER-TABLE FILAMENT TRANSFORMER IN H.V. ASSEMBLY
XLU-	FILAMENT DRIVE TO LARGE UNDER-TABLE FILAMENT
XRP-	UNDER-TABLE LARGE FILAMENT PREHEAT
XS1-	SPACE CHARGE SELECT SIGNAL FROM "XCC" MA STATION 1
XS2-	SAME AS ABOVE MA STATION 2
XS3-	SAME AS ABOVE MA STATION 3
XS4-	SAME AS ABOVE MA STATION 4
XS5-	SAME AS ABOVE MA STATION 5
XS6-	SAME AS ABOVE MA STATION 6
XS7-	SAME AS ABOVE MA STATION 7
XS8-	SAME AS ABOVE MA STATION 8
XSP-	CONTINUATION AFTER CIRCUIT BREAKER OF "115S"
XSO-	FILAMENT DRIVE
XSPP-	CONTINUATION OF "XSC" AFTER FUSE (INPUT TO FILAMENT CONTROL TRANSFORMER)
XSR1-	INTERMEDIATE CONNECTION IN SPOT/FLUORO SPACE CHARGE SELECT
XSS1-	SPACE CHARGE SELECT FROM SPOT/FLUORO mA (CONNECTS TO "XS1" IN 200L SPOT MODE)
XST-	JUMPER FOR "XS" SELECTION CONTINUATION ("XS" TRANSFER)
XSU-	FILAMENT DRIVE TO SMALL UNDER-TABLE FILAMENT TRANSFORMER

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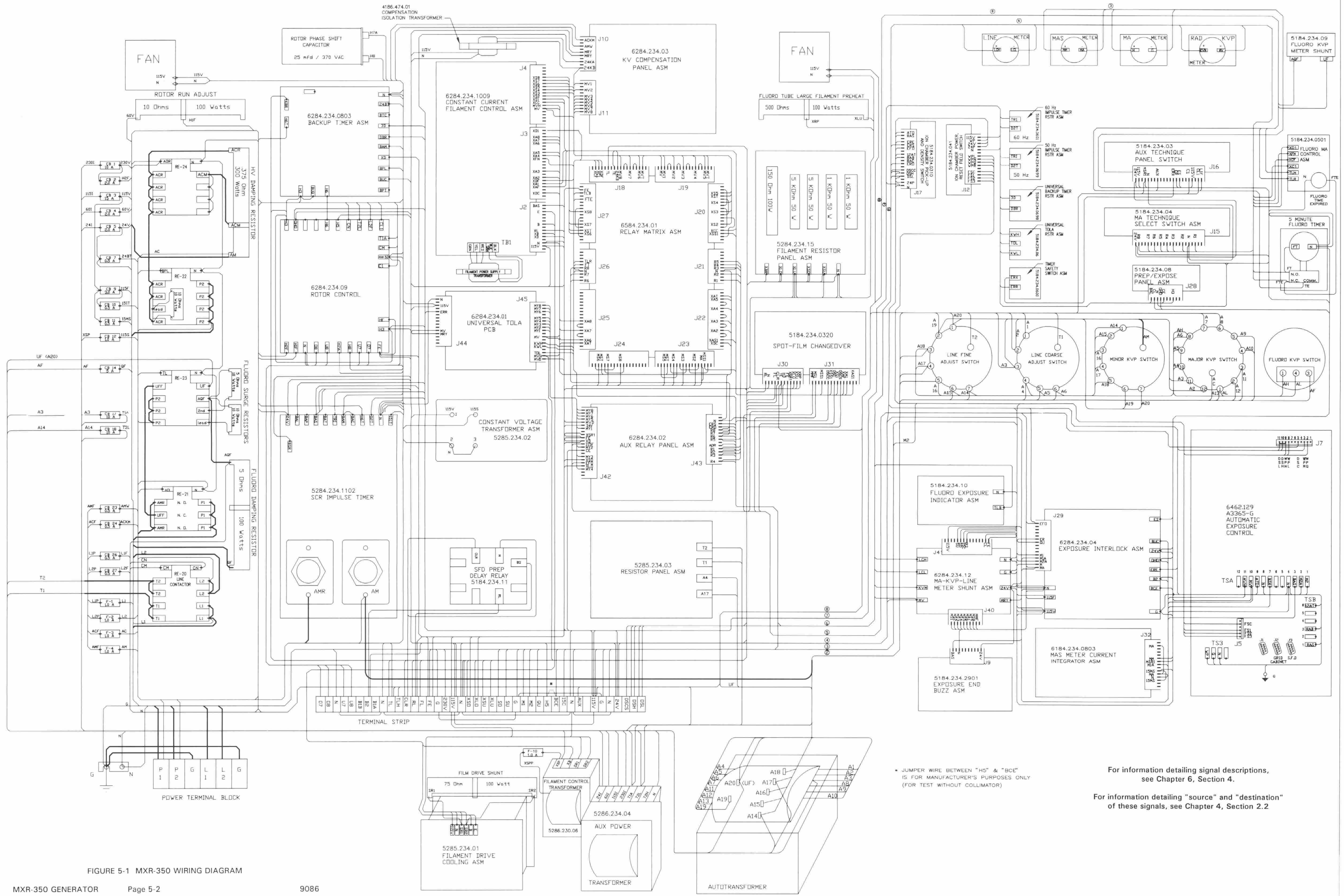
SECTION 5 - PARTS LISTS

NOTE

Pages in this section are printed on one side, only.


FAN
115V
N
ROTOR RUN ADJUST
10 Ohms
100 Watts
ROTOR PHASE SHIFT CAPACITOR
25 mfd / 370 VAC
4186.474.01 COMPENSATION ISOLATION TRANSFORMER
6284.234.03 KV COMPENSATION PANEL ASM
J10
J11
6284.234.0803 BACKUP TIMER ASM
6284.234.1009 CONSTANT CURRENT FILAMENT CONTROL ASM
J4
J3
J2
TB1
FILAMENT POWER SUPPLY TRANSFORMER
HV DAMPING RESISTOR
375 Ohm 300 Watts
RE-24
RE-22
RE-23
RE-21
RE-20 LINE CONTACTOR
6284.234.09 ROTOR CONTROL
6284.234.01 UNIVERSAL TOLA PCB
J44
J45
6584.234.01 RELAY MATRIX ASM
J18
J19
J20
J21
J22
J23
J24
J25
J26
J27
FLUORO SURGE RESISTORS
5 Ohms 10 Watts
FLUORO DAMPING RESISTOR
5 Ohms 100 Watts
CONSTANT VOLTAGE TRANSFORMER ASM 5285.234.02
6284.234.02 AUX RELAY PANEL ASM
J42
J43
5284.234.1102 SCR IMPULSE TIMER
AMR
AM
SFD PREP DELAY RELAY 5184.234.11
5285.234.03 RESISTOR PANEL ASM
FAN
FLUORO TUBE LARGE FILAMENT PREHEAT
500 Ohms
100 Watts
150 Ohm 100W
5 KOhm 50 W
5 KOhm 50 W
1 KOhm 50 W
1 KOhm 50 W
5284.234.15 FILAMENT RESISTOR PANEL ASM
5184.234.0320 SPOT-FILM CHANGEOVER
J30
J31
J17
J12
LINE METER
MAS METER
MA METER
RAD KVP METER
5184.234.09 FLUORO KVP METER SHUNT
60 Hz IMPULSE TIMER RSTR ASM
50 Hz IMPULSE TIMER RSTR ASM
UNIVERSAL BACKUP TIMER RSTR ASM
UNIVERSAL TOLA RSTR ASM
TIMER SAFETY SWITCH ASM
5184.234.03 AUX TECHNIQUE PANEL SWITCH
J16
5184.234.04 MA TECHNIQUE SELECT SWITCH ASM
J15
5184.234.08 PREP/EXPOSE PANEL ASM
J28
5184.234.0501 FLUORO MA CONTROL ASM
FLUORO TIME EXPIRED
5 MINUTE FLUORO TIMER
LINE FINE ADJUST SWITCH
LINE COARSE ADJUST SWITCH
MINOR KVP SWITCH
MAJOR KVP SWITCH
FLUORO KVP SWITCH
5184.234.10 FLUORO EXPOSURE INDICATOR ASM
6284.234.04 EXPOSURE INTERLOCK ASM
J29
6284.234.12 MA-KVP-LINE METER SHUNT ASM
J40
J41
5184.234.2901 EXPOSURE END BUZZ ASM
J9
6184.234.0803 MAS METER CURRENT INTEGRATOR ASM
J32
6462.129 A3365-G AUTOMATIC EXPOSURE CONTROL
J7
TSA
TSB
TS3
J5
TERMINAL STRIP
POWER TERMINAL BLOCK
P1
P2
G
L1
L2
G
FILM DRIVE SHUNT
75 Ohm
100 Watt
F-10 10 A
FILAMENT CONTROL TRANSFORMER
5286.234.04 AUX POWER
5286.230.06
TRANSFORMER
5285.234.01 FILAMENT DRIVE COOLING ASM
AUTOTRANSFORMER

* JUMPER WIRE BETWEEN "H5" & "BCE" IS FOR MANUFACTURER'S PURPOSES ONLY (FOR TEST WITHOUT COLLIMATOR)

For information detailing signal descriptions, see Chapter 6, Section 4.

For information detailing "source" and "destination" of these signals, see Chapter 4, Section 2.2

FIGURE 5-1 MXR-350 WIRING DIAGRAM

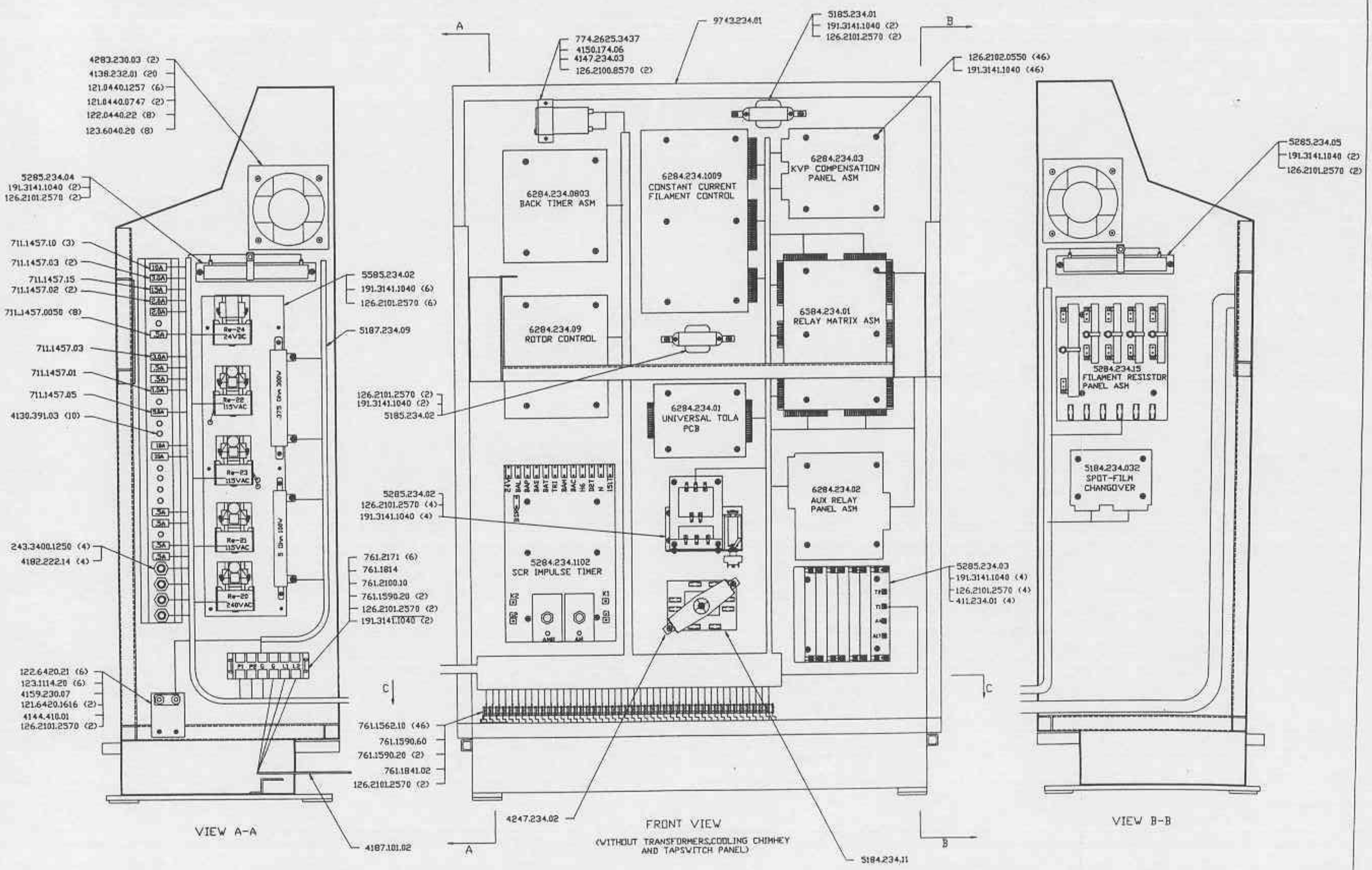

4283.230.03 (2)
4138.232.01 (20
121.0440.1257 (6)
121.0440.0747 (2)
122.0440.22 (8)
123.6040.20 (8)
5285.234.04
191.3141.1040 (2)
126.2101.2570 (2)
711.1457.10 (3)
711.1457.03 (2)
711.1457.15
711.1457.02 (2)
711.1457.0050 (8)
711.1457.03
711.1457.01
711.1457.05
4130.391.03 (10)
243.3400.1250 (4)
4182.222.14 (4)
122.6420.21 (6)
123.1114.20 (6)
4159.230.07
121.6420.1616 (2)
4144.410.01
126.2101.2570 (2)
Re-24
24VDC
Re-22
115VAC
Re-23
115VAC
Re-21
115VAC
Re-20
240VAC
.375 Ohm 300W
5 Ohm 100W
P1 P2 G G L1 L2
5585.234.02
191.3141.1040 (6)
126.2101.2570 (6)
5187.234.09
126.2101.2570 (2)
191.3141.1040 (2)
5185.234.02
5285.234.02
126.2101.2570 (4)
191.3141.1040 (4)
761.2171 (6)
761.1814
761.2100.10
761.1590.20 (2)
126.2101.2570 (2)
191.3141.1040 (2)
C
761.1562.10 (46)
761.1590.60
761.1590.20 (2)
761.1841.02
126.2101.2570 (2)
4187.101.02
VIEW A-A
A
774.2625.3437
4150.174.06
4147.234.03
126.2100.8570 (2)
9743.234.01
5185.234.01
191.3141.1040 (2)
126.2101.2570 (2)
B
126.2102.0550 (46)
191.3141.1040 (46)
6284.234.0803
BACK TIMER ASM
6284.234.1009
CONSTANT CURRENT
FILAMENT CONTROL
6284.234.03
KVP COMPENSATION
PANEL ASM
6284.234.09
ROTOR CONTROL
6584.234.01
RELAY MATRIX ASM
6284.234.01
UNIVERSAL TOLA
PCB
6284.234.02
AUX RELAY
PANEL ASM
5284.234.1102
SCR IMPULSE TIMER
5285.234.03
191.3141.1040 (4)
126.2101.2570 (4)
411.234.01 (4)
C
4247.234.02
FRONT VIEW
(WITHOUT TRANSFORMERS,COOLING CHIMNEY
AND TAPSWITCH PANEL)
5184.234.11
A
B
5285.234.05
191.3141.1040 (2)
126.2101.2570 (2)
5284.234.15
FILAMENT RESISTOR
PANEL ASM
5184.234.032
SPOT-FILM
CHANGOVER
C
VIEW B-B

FIGURE 5-2 CONTROL ASM (PART 1) 5785.234.01

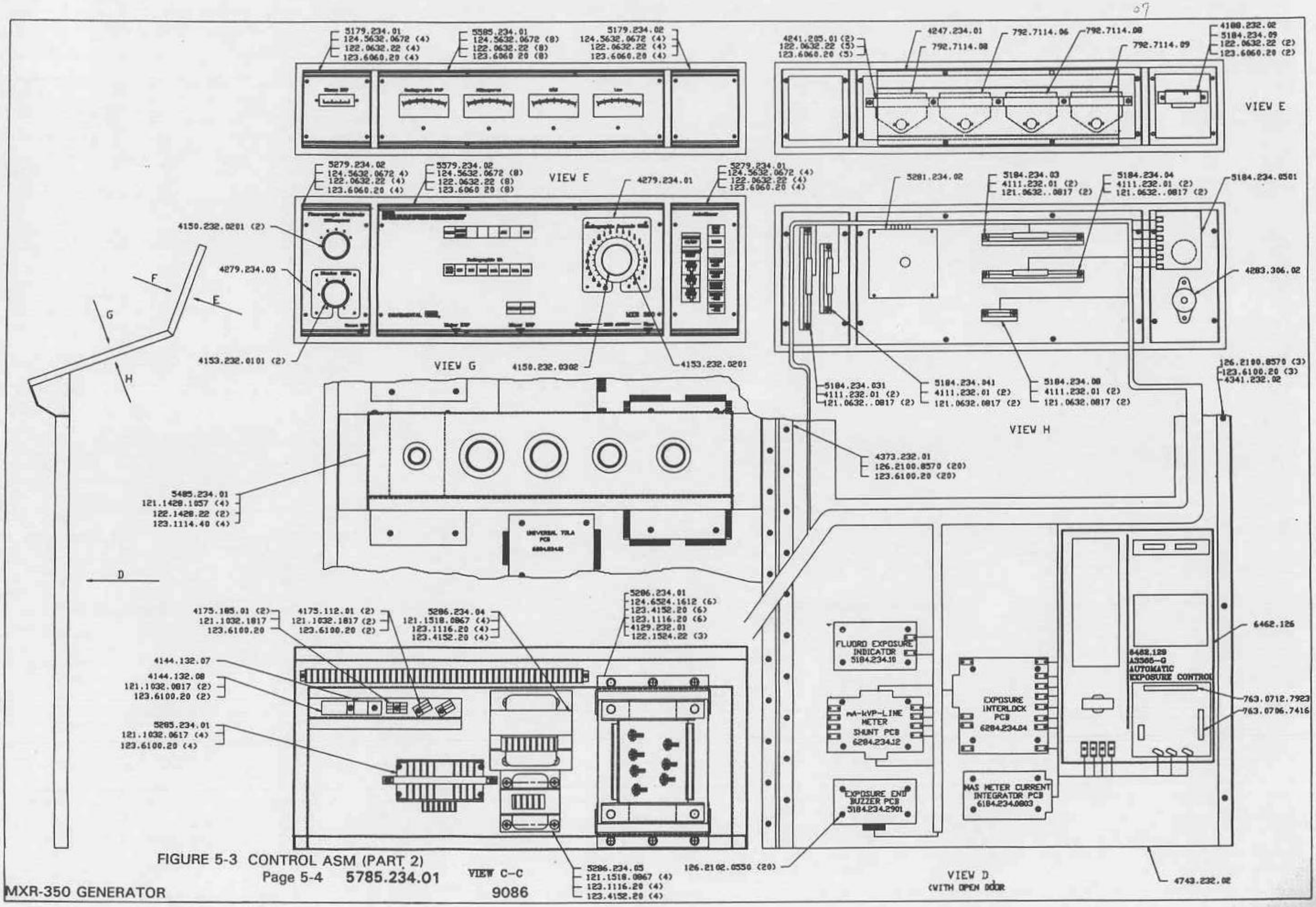

5179.234.01
124.5632.0672 (4)
122.0632.22 (4)
123.6060.20 (4)
5585.234.01
124.5632.0672 (8)
122.0632.22 (8)
123.6060 20 (8)
5179.234.02
124.5632.0672 (4)
122.0632.22 (4)
123.6060.20 (4)
4241.205.01 (2)
122.0632.22 (5)
123.6060.20 (5)
4247.234.01
792.7114.08
792.7114.06
792.7114.08
792.7114.09
4188.232.02
5184.234.09
122.0632.22 (2)
123.6060.20 (2)
VIEW E
5279.234.02
124.5632.0672 4)
122.0632.22 (4)
123.6060.20 (4)
5579.234.02
124.5632.0672 (8)
122.0632.22 (8)
123.6060 20 (8)
VIEW E
4279.234.01
5279.234.01
124.5632.0672 (4)
122.0632.22 (4)
123.6060.20 (4)
4150.232.0201 (2)
4279.234.03
4153.232.0101 (2)
F
E
G
H
VIEW G
4150.232.0302
4153.232.0201
5281.234.02
5184.234.03
4111.232.01 (2)
121.0632..0817 (2)
5184.234.04
4111.232.01 (2)
121.0632..0817 (2)
5184.234.0501
4283.306.02
5184.234.031
4111.232.01 (2)
121.0632..0817 (2)
5184.234.041
4111.232.01 (2)
121.0632.0817 (2)
5184.234.08
4111.232.01 (2)
121.0632.0817 (2)
126.2100.8570 (3)
123.6100.20 (3)
4341.232.02
VIEW H
4373.232.01
126.2100.8570 (20)
123.6100.20 (20)
5485.234.01
121.1428.1057 (4)
122.1428.22 (2)
123.1114.40 (4)
UNIVERSAL TOLA PCB
D
4175.185.01 (2)
121.1032.1817
123.6100.20
4175.112.01 (2)
121.1032.1817 (2)
123.6100.20 (2)
5286.234.04
121.1518.0867 (4)
123.1116.20 (4)
123.4152.20 (4)
5286.234.01
124.6524.1612 (6)
123.4152.20 (6)
123.1116.20 (6)
4129.232.01
122.1524.22 (3)
4144.132.07
4144.132.08
121.1032.0817 (2)
123.6100.20 (2)
5285.234.01
121.1032.0617 (4)
123.6100.20 (4)
FLUORO EXPOSURE INDICATOR 5184.234.10
mA-kVP-LINE METER SHUNT PCB 6284.234.12
EXPOSURE END BUZZER PCB 5184.234.2901
EXPOSURE INTERLOCK PCB 6284.234.04
MAS METER CURRENT INTEGRATOR PCB 6184.234.0803
6462.129
A3366-G
AUTOMATIC
EXPOSURE CONTROL
6462.126
763.0712.7923
763.0706.7416
VIEW C-C
5286.234.05
121.1518.0867 (4)
123.1116.20 (4)
123.4152.20 (4)
126.2102.0550 (20)
VIEW D
(WITH OPEN DOOR
4743.232.02

FIGURE 5-3 CONTROL ASM (PART 2)

5785.234.01

9086

	Part Number	Description	Quantity	Reference Designators
1.	121.0440.0747	4-40 X 7/16 Phlps Flstr Steel Screw	2 EA	
2.	121.0440.1257	4-40 X 3/4 Pan Head Phillips Screw	6 EA	
3.	121.0632.0657	6-32 X 3/8 Pan Steel Phillips Screw	9 EA	
4.	121.1032.0477	10-32 X 1/4 Flat Undercut Stl Screw	6 EA	
5.	121.1032.0617	10-32 X 3/8 Round Steel Phlps Screw	4 EA	
6.	121.1032.0817	10-32 X 1/2 Round Steel Phlps Screw	3 EA	
7.	121.1428.1057	1/4-28 X 5/8 Pan Steel Philps Screw	4 EA	
8.	121.1518.0867	5/16-18 X 1/2 Truss Stl Phlps Screw	18 EA	
9.	121.6032.0816	10-32 X 1/2 Round Head Brass Screw	12 EA	
10.	121.6420.1616	1/4-20 X 1 Round Head Brass Screw	2 EA	
11.	122.0440.22	4-40 Double Chamfered Hex Steel Nut	8 EA	
12.	122.0632.22	6-32 Double Chamfered Hex Steel Nut	39 EA	
13.	122.1428.22	1/4-28 Double Chamfered Stl Hex Nut	2 EA	
14.	122.1524.22	5/16-24 Double Chamferd Hex Stl Nut	3 EA	
15.	122.6032.21	10-32 Brass Double Chamferd Hex Nut	15 EA	
16.	122.6420.21	1/4-20 Brass Double Chamfrd Hex Nut	6 EA	
17.	123.1114.20	9/32ID 5/80D 1/16Thk Stl SAE Washer	6 EA	
18.	123.1114.40	9/32Id 5/80d 1/16Thk Stl Sae Washer	4 EA	
19.	123.1115.50	11/32ID 11/160D 1/16T Stl Sae Washr	18 EA	
20.	123.1116.20	13/32Id 13/160d 1/16T Stl Sae Washr	8 EA	
21.	123.1304.20	1/8Id 9/320d .025T Mch Screw Washer	14 EA	
22.	123.1306.20	.150ID .3750D .032T Mach Scrw Washr	9 EA	
23.	123.1405.20	1/8ID 1/40D 1/32T Stl Elect.Washer	16 EA	
24.	123.4142.20	1/4 Medium Pattern Split Lockwasher	13 EA	
25.	123.4152.20	5/16 Medium Pattrn Split Lockwasher	14 EA	
26.	123.4162.20	3/8 Medium Pattern Split Lockwasher	4 EA	

. . . continued on next page

TABLE 5-1 Parts List for 5785.234.01
MXR 350 Control Assembly

	Part Number	Description	Quantity	Designators
27.	123.6040.20	#4 Internal Tooth Steel Lockwasher	8 EA	
28.	123.6060.20	#6 Internal Tooth Steel Lockwasher	35 EA	
29.	123.6100.20	#10 Internal Tooth Steel Lockwashr	30 EA	
30.	124.5632.0672	6-32 X 3/8 Button Head Cap Screw	32 EA	
31.	124.6524.1612	5/16-24 X 1 Hex Head Cap Screw	6 EA	
32.	126.2060.6570	6B X 3/8 Phil Pan Head Steel Screw	4 EA	
33.	126.2080.6570	8B X 3/8 Pan Head Steel Screw	26 EA	
34.	126.2100.8570	10B X 1/2 Phil Pan Head Steel Screw	99 EA	
35.	126.2101.0570	10B X 5/8 Phil Pan Head Steel Screw	4 EA	
36.	126.2101.2570	10B X 3/4 Phil Pan Head Steel Screw	28 EA	
37.	126.2102.0550	10B X 1-1/4 Phil Pan Head Stl Screw	66 EA	
38.	129.6120.7731	1/8"ODx.212L Domed Pop Rivet	16 EA	
39.	137.9101.0080	Adhesive Felt 1/16 X 1/2	5 FT	
40.	137.9101.20	1/16 X 2 Adhesive Felt	6 FT	
41.	191.2071.4670	8-32 Type J Tinnerman Nut	2 EA	
42.	191.3141.1040	10Z Type U Tinnerman Nut	187 EA	
43.	243.3400.1250	1 Amp 250 Volt Tubular Fuse	4 EA	
44.	4111.232.01	5/16Hex X 3/8 Spacer 6-32 Thread	10 EA	
45.	4111.234.01	MXR-350 Resistor Pnl Mntng Bushing	4 EA	
46.	4129.232.01	Concorde Auto Trnsfmr Mounting Strp	1 EA	
47.	4130.391.03	3/8 Inch Steel Hole Plug	10 EA	
48.	4136.391.03	3/8 Inch Diameter Plug Button	9 EA	
49.	4138.232.01	4.5 Square Fan Finger Guard	2 EA	
50.	4141.391.07	Panelex Cable Cradle Support	16 EA	
51.	4144.132.07	3/4 Inch Cable Clamp	1 EA	
52.	4144.132.08	1" Cable Clamp	1 EA	

. . . continued on next page

TABLE 5-1 Parts List for 5785.234.01
MXR 350 Control Assembly

	Part Number	Description	Quantity	Designators
53.	4144.174.10	D Washer For Nylon Strap	2 EA	
54.	4144.234.01	Minute Timer Switch 1/2 Inch Wrench	1 EA	
55.	4144.410.01	Binding Post Jumper	1 EA	
56.	4146.132.01	C.V.T.Capacitor Mounting Bracket	2 EA	
57.	4146.403.01	300-100 Tap Switch Plate	1 EA	
58.	4147.222.05	Transformer PCP Mounting Bracket	6 EA	
59.	4147.234.03	Mil Cap Mounting Bracket	1 EA	
60.	4150.232.0201	CXF-1000 1.10 Dia Med Gray Disc	2 EA	
61.	4150.232.0301	CXF-1000 2.06 Dia Med Gray Disc	2 EA	
62.	4150.232.0302	AMERISYS 2.06 Dia Light Gray Disc	1 EA	
63.	4150.232.04	Concorde Switch Legends	1 EA	
64.	4150.261.01	Electrovert Clip N1	39 EA	
65.	4150.261.02	Electrovert Clip N3	14 EA	
66.	4150.261.07	Electrovert Cradle C1	20 EA	
67.	4150.261.08	Electrovert Cradle C2	26 EA	
68.	4150.261.09	Electrovert Cradle C3	9 EA	
69.	4153.222.03	Slide Band And Knob Asm, 100W Res	3 EA	
70.	4153.232.0101	CXC 1/4 Hole 1-7/8 OD Gray Knob	2 EA	
71.	4153.232.0201	CXC 1/4 Hole 3 OD Gray Knob	1 EA	
72.	4159.230.07	3P G To N Tie Bar Insulator Panel	1 EA	
73.	4159.235.04	Meter Terminal Support	1 EA	
74.	4175.084.01	3/8 Inch Cable Clamp	1 EA	
75.	4175.112.01	7/16 Inch Cable Clamp	2 EA	
76.	4175.185.01	5/16 Inch Cable Clamp	2 EA	
77.	4179.234.01	MXR-350 Generator Rating Label	1 EA	
78.	4179.234.03	MXR-350 Manufactured Label	1 EA	

. . . continued on next page

TABLE 5-1 Parts List for 5785.234.01
MXR 350 Control Assembly

	Part Number	Description	Quantity	Designators
79.	4179.234.06	MXR-350 Control Cabinet Fuse Label	1 EA	
80.	4179.234.09	MXR-350 Serial Number Label	1 EA	
81.	4179.234.16	MXR-350 Frequency Conversion Tag	2 EA	
82.	4181.232.01	In-line Fuse Holder 1/4 x 1-1/4	1 EA	
83.	4181.232.02	1-1/4 Amp AGC or 3AG Fuse	1 EA	
84.	4182.216.07	10 Contact Edge Connector No Ears	8 EA	
85.	4182.216.08	12 Contact Edge Connector No Ears	1 EA	
86.	4182.216.09	15 Contact Edge Connector No Ears	7 EA	
87.	4182.216.10	18 Contact Edge Connector No Ears	11 EA	
88.	4182.216.11	22 Contact Edge Connector No Ears	5 EA	
89.	4182.222.14	Fuse Holder And Indicator	4 EA	
90.	4182.240.02	Multiplier Terminal	20 EA	
91.	4182.410.03	Coaxial Cable Connector	4 EA	
92.	4188.232.02	0-150 VDC Simpson #1522 Voltmeter	1 EA	
93.	4241.205.01	Challenger Meter Mount Bracket	2 EA	
94.	4247.234.01	MXR-350 Meters Cover Bracket	1 EA	
95.	4247.234.02	MXR-350 Delay Relay Secure Bracket	1 EA	
96.	4259.391.02	Power Unit Cable Entrance Gate	1 EA	
97.	4279.234.01	50/60Hz Radiographic Sec Tmr Nmplt	1 EA	
98.	4279.234.03	50/60 Hz Fluoro Minutes Tmr Nmplt	1 EA	
99.	4283.230.03	115 Volt .24 Amp 115Cfm Boxer Fan	2 EA	
100.	4283.306.02	5 Minute Fluoro Timer	1 EA	
101.	4341.232.02	Concorde Control Door Closure Angle	1 EA	
102.	4373.232.01	Concorde Control Hinge	1 EA	
103.	4379.391.01	31 Circuit Breaker Marker Strip	2 EA	
104.	4743.232.02	Concorde Control Door	1 EA	

. . . continued on next page

TABLE 5-1 Parts List for 5785.234.01
MXR 350 Control Assembly

	Part Number	Description	Quantity	Reference Designators
105.	5179.234.01	Military Fluoroscopic Mtr Nmplt Asm	1 EA	
106.	5179.234.02	Military Upper Right Blank Pnl Asm	1 EA	
107.	5184.225.01	Wakefield-650 Gnrtr Power Cable	1 EA	
108.	5184.234.03	MXR-350 Aux Technique Panel Asm	1 EA	
109.	5184.234.0310	MXR-350 Ion Chamber Pkup & Dnsty Sw	1 EA	
110.	5184.234.0320	MXR-350 Spotfilm Changeover Asm	1 EA	
111.	5184.234.04	MXR-350 mA Tech Select Switch Asm	1 EA	
112.	5184.234.0410	MXR-350 Ion Chmbr Pwr-Reset-Fld Sw	1 EA	
113.	5184.234.0501	MXR-350 Fluoro mA Control Board Asm	1 EA	
114.	5184.234.08	MXR-350 Prepare/Expose Panel Asm	1 EA	
115.	5184.234.09	MXR-350 Fluoro kVp Meter Shunt Asm	1 EA	
116.	5184.234.10	MXR-350 Fluoro Exposure Indictr Asm	1 EA	
117.	5184.234.11	MXR-350 SFD Prep Delay Relay Asm	1 EA	
118.	5184.234.2901	MXR-350 24VDC Exposure End Buzz Asm	1 EA	
119.	5184.398.03	Barton Main Line Cable	1 EA	
120.	5185.234.01	115/25V 1A Transformer Asm	1 EA	
121.	5185.234.02	115 Tpd 10/20/40 Ct .3A Trnsf Asm	1 EA	
122.	5187.101.08	Box "B" To Generator Power Cable	1 EA	
123.	5187.232.05	3 #4 Transformer Power Cable Asmbly	1 EA	
124.	5187.234.06	MXR-350 Generator- H.V.T. Cntrl Cbl	1 EA	
125.	5187.234.09	MXR-350 Control Wire Set	1 EA	
126.	5279.234.01	Military Autotmr Pshbutton Nplt Asm	1 EA	
127.	5279.234.02	Military Flroscpc Control Nmplt Asm	1 EA	
128.	5281.234.02	MXR-350 Timer Switch Assembly	1 EA	
129.	5284.234.1102	MXR-350 235A 800V Impls Tmr-Contctr	1 EA	
130.	5284.234.15	MXR-350 3P Filament Resistr Pnl Asm	1 EA	

. . . continued on next page

TABLE 5-1 Parts List for 5785.234.01
MXR 350 Control Assembly

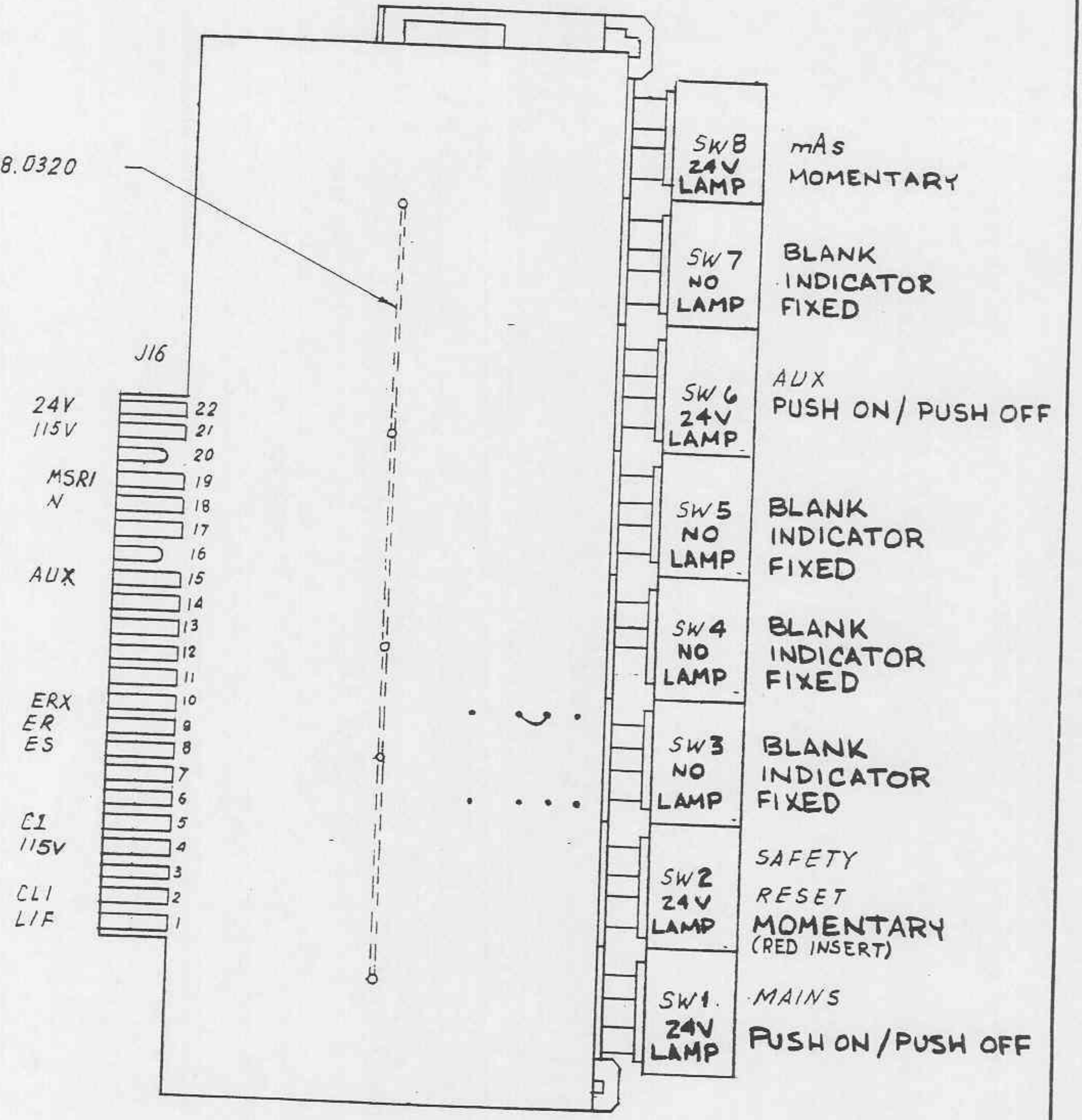
	Part Number	Description	Quantity	Reference Designators
131.	5285.234.01	MXR-350 3P Filmnt Drive Cooling Asm	1 EA	
132.	5285.234.02	Constant Voltage Transformer Asm	1 EA	
133.	5285.234.03	MXR-350 Resistor Panel Asm	1 EA	
134.	5285.234.04	MXR-350 10R Resistor Mntng Pnl Asm	1 EA	
135.	5285.234.05	MXR-350 500R Resistor Mntng Pnl Asm	1 EA	
136.	5286.234.01	Mil Gen 50/60Hz Autotransformer	1 EA	
137.	5286.234.04	Aux Pwr Supply 50/60Hz Xfmr Asm	1 EA	
138.	5286.234.05	Fil. Xfmr Supply Asm 50/60Hz	1 EA	
139.	5485.234.01	MXR-350 Tap Switches Panel Asm	1 EA	
140.	5579.234.01	Military Upper Center Nameplate Asm	1 EA	
141.	5579.234.02	Military Lower Pushbutton Nmplt Asm	1 EA	
142.	5585.234.02	MXR 350 Contactor Panel Asm	1 EA	
143.	6184.234.0803	MXR-350 mAs Mtr Current Intgrtr Asm	1 EA	
144.	6284.234.01	MXR-350 Universal TOLA Assembly	1 EA	
145.	6284.234.02	MXR-350 Auxilary Relay Panel Asm	1 EA	
146.	6284.234.03	MXR-350 kVp Compensation Panel Asm	1 EA	
147.	6284.234.04	MXR-350 Exposure Interlock Pnl Asm	1 EA	
148.	6284.234.0803	MXR-350 Backup Timer Panel Asm	1 EA	
149.	6284.234.09	MXR-350 Rotor Cntrl W/Phototransist	1 EA	
150.	6284.234.1009	MXR-350 Cnstnt Crnt Flmnt Cntrl Asm	1 EA	
151.	6284.234.12	MXR-350 mA-KVP Line Meter Shunt Asm	1 EA	
152.	6462.126.	A3365-G AEC Control, Military Versn	1 EA	
153.	6584.234.01	MXR-350 Relay Matrix PCB Asm	1 EA	
154.	711.1457.0050	0.5 Amp Circuit Breaker	8 EA	
155.	711.1457.01	1.0 Amp Circuit Breaker	1 EA	
156.	711.1457.02	2.0 Amp Circuit Breaker	2 EA	

. . . continued on next page

TABLE 5-1 Parts List for 5785.234.01
MXR 350 Control Assembly

	Part Number	Description	Quantity	Designators
157.	711.1457.03	3.0 Amp Circuit Breaker	2 EA	
158.	711.1457.05	5.0 Amp Circuit Breaker	2 EA	
159.	711.1457.10	10.0 Amp Circuit Breaker	3 EA	
160.	711.1457.15	15.0 Amp Circuit Breaker	1 EA	
161.	733.1441.0252	14 Ga 1 Conductor Grn Hookup Wire	6 FT	
162.	761.1562.10	4-Way Medium Duty Terminal Block	46 EA	
163.	761.1590.20	Channel Mounting Clamp	4 EA	
164.	761.1590.60	Nylon Holding Plug	1 EA	
165.	761.1814.	14 Term Blank Terminal Channel	1 EA	
166.	761.1841.02	41 Term 2 Hole Terminal Channel	1 EA	
167.	761.2100.10	Buchanan Large Terminal End Piece	1 EA	
168.	761.2100.60	Large Size Barrier	1 EA	
169.	761.2171.	125 Amp 14-0 Wire Terminal Block	6 EA	
170.	763.0706.7416	6 Pin Entrelec Plug	1 EA	
171.	763.0712.7923	12 Pin Entrelec Plug	1 EA	
172.	774.2625.3437	25 Mfd 370 Volt AC Oil Capacitor	1 EA	
173.	792.7114.06	0-100Mas FS 1Ma Movement Mdl 83T	1 EA	
174.	792.7114.07	0-10/100/400Ma FS 1Ma Mvmnt Mdl 83T	1 EA	
175.	792.7114.08	Line Set Indicate 1Ma Mvmnt Mdl 83T	1 EA	
176.	792.7114.09	0-150Kvp FS 1 Ma Movement Mdl 83T	1 EA	
177.	9145.234.01	Generator Cable Hanger Assembly	2 EA	
178.	9523.201.30	Cncrd Ansurth Table Cable 30Ft	1 EA	
179.	9743.234.01	Military Control Cabinet	1 EA	

TABLE 5-1 Parts List for 5785.234.01
MXR 350 Control Assembly

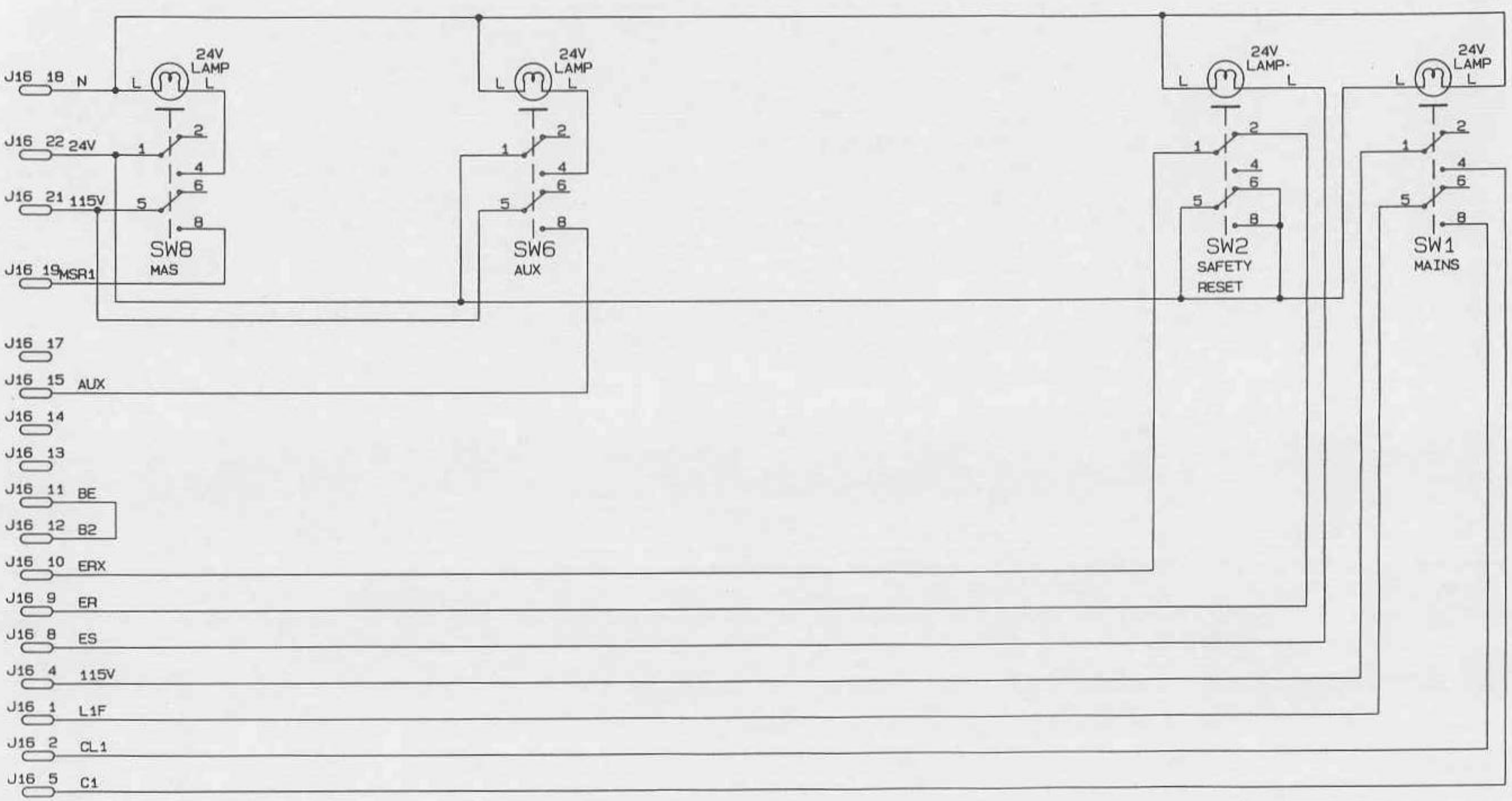

738.0320
J16
24V
115V
MSRI
N
AUX
ERX
ER
ES
C1
115V
CLI
L/F
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
SW8
24V
LAMP
mAs
MOMENTARY
SW7
NO
LAMP
BLANK
INDICATOR
FIXED
SW6
24V
LAMP
AUX
PUSH ON / PUSH OFF
SW5
NO
LAMP
BLANK
INDICATOR
FIXED
SW4
NO
LAMP
BLANK
INDICATOR
FIXED
SW3
NO
LAMP
BLANK
INDICATOR
FIXED
SW2
24V
LAMP
SAFETY
RESET
MOMENTARY
(RED INSERT)
SW1
24V
LAMP
MAINS
PUSH ON / PUSH OFF

MXR-350 AUX TECHNIQUE PANEL ASM

FIGURE 5-4 LAYOUT FOR 5184.234.03

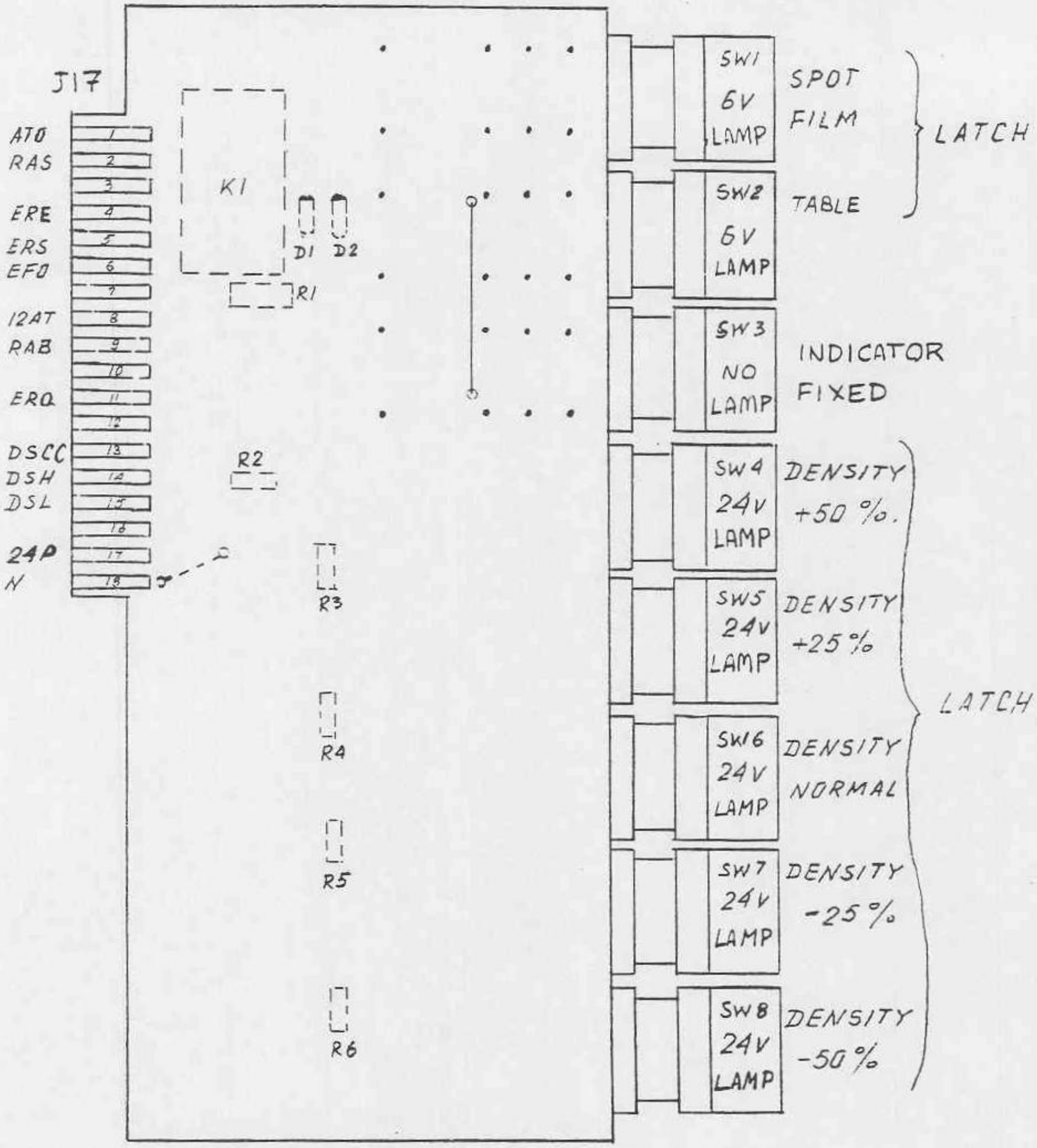
	Part Number	Description	Quantity	Reference Designators
1.	135.3416.01	#16 Teflon Insulating Tubing	1 FT	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4184.234.03	MXR-350 Aux Technique Panel PC Blnk	1 EA	
4.	717.0111.20	Ledex Indicator Module	4 EA	SW2,SW4,SW5,SW6
5.	717.0111.30	Ledex Switch Module PC Terminal	4 EA	SW1,SW3,SW7,SW8
6.	717.0112.20	Ledex Maintain Plate	2 EA	
7.	717.0112.60	Ledex Switch Torsion Spring	2 EA	
8.	717.0112.80	Ledex Switch Back Plate	2 EA	
9.	717.0113.12	3/4 Square PB Switch Light Shield	8 EA	
10.	717.0113.13	3/4" Square PB Switch Clear Outcap	8 EA	
11.	717.0113.1420	Red Ledex Lens Cap Insert	1 EA	
12.	717.0113.1491	White Ledex Lens Cap Insert	8 EA	
13.	717.0113.3210	Ledex 24 Volt Slide Base Bulb 20Ma	4 EA	LAMP: SW1,SW3,SW7,SW8
14.	717.0114.10	Ledex Switch Mounting Block	2 EA	
15.	717.0114.50	Hex Head Module Mounting Screw	40 EA	
16.	717.0115.1080	8 Segment Ledex Mounting Channel	1 EA	
17.	738.0320.	20 Awg Solid Tinned Copper Wire	1 FT	

TABLE 5-2 Parts List for 5184.234.03
MXR-350 Aux Technique Panel Asm


J16 18 N
J16 22 24V
J16 21 115V
J16 19 MSR1
J16 17
J16 15 AUX
J16 14
J16 13
J16 11 BE
J16 12 B2
J16 10 ERX
J16 9 ER
J16 8 ES
J16 4 115V
J16 1 L1F
J16 2 CL1
J16 5 C1
24V LAMP
L
L
1
2
4
5
6
8
SW8
MAS
24V LAMP
L
L
1
2
4
5
6
8
SW6
AUX
24V LAMP
L
L
1
2
4
5
6
8
SW2
SAFETY
RESET
24V LAMP
L
L
1
2
4
5
6
8
SW1
MAINS

MXR-350 AUX TECHNIQUE PANEL ASM

FIGURE 5-5 SCHEMATIC FOR 5184.234.03


J17
ATO
RAS
ERE
ERS
EFO
12AT
RAB
ERQ
DSCC
DSH
DSL
24P
N
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
K1
D1
D2
R1
R2
R3
R4
R5
R6
SW1 6V LAMP
SPOT FILM
LATCH
SW2 6V LAMP
TABLE
SW3 NO LAMP
INDICATOR FIXED
SW4 24V LAMP
DENSITY +50 %.
SW5 24V LAMP
DENSITY +25 %
SW6 24V LAMP
DENSITY NORMAL
SW7 24V LAMP
DENSITY -25 %
SW8 24V LAMP
DENSITY -50 %
LATCH

MXR-350 ION CHMBR PKUP & DENSTY

FIGURE 5-6 LAYOUT FOR 5184.234.0310

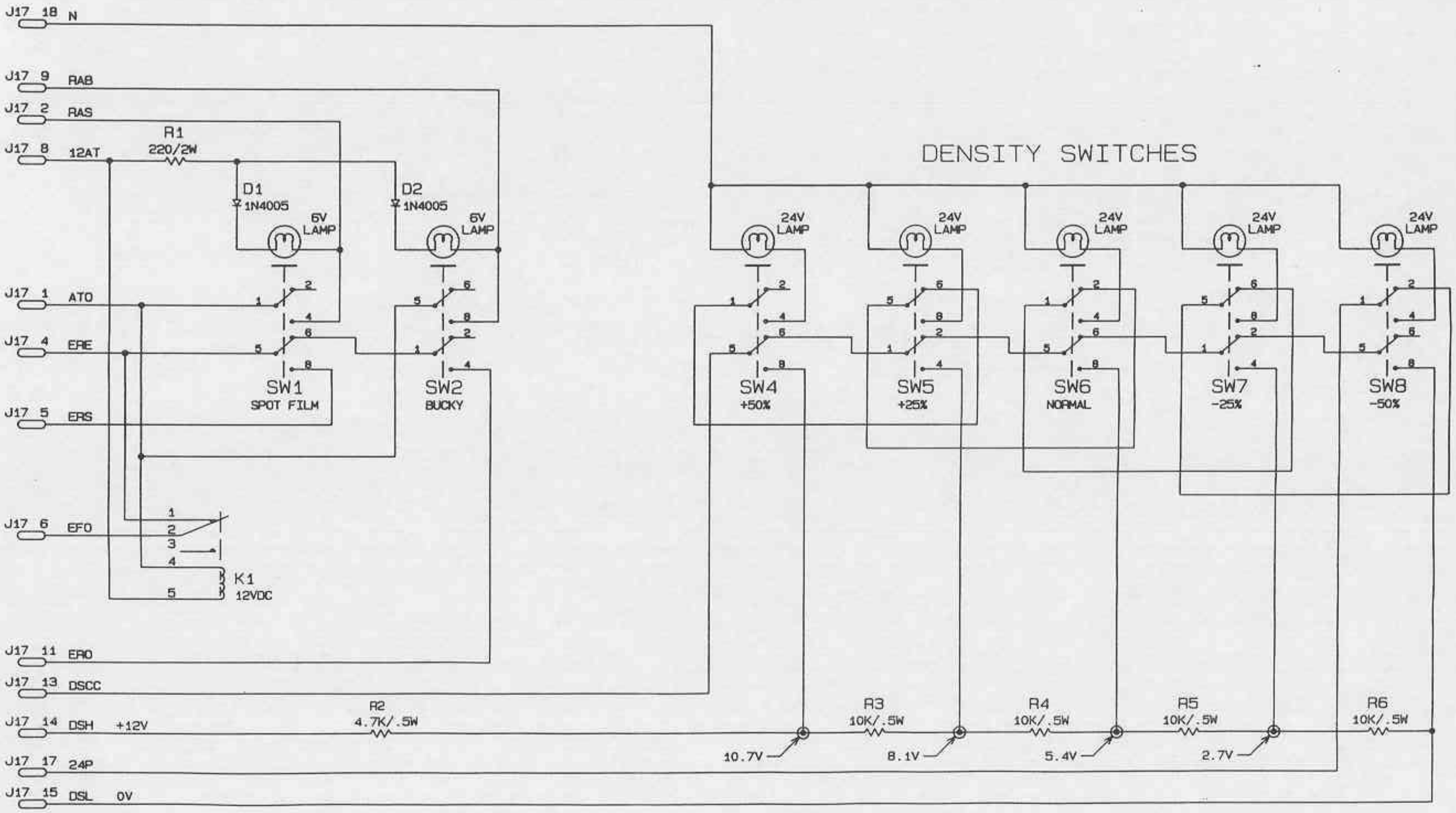
	Part Number	Description	Quantity	Designators
1.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2.	4180.503.25	1 Amp 12 VDC Low Profile PC Relay	1 EA	
3.	4184.234.0310	MXR-350 Ion Chmbr Dnsty Sw PC Blnk	1 EA	
4.	717.0111.20	Ledex Indicator Module	1 EA	SW3
5.	717.0111.30	Ledex Switch Module PC Terminal	7 EA	SW1,SW2,SW4-8
6.	717.0112.10	Ledex Reciprocal Release Plate	7 EA	
7.	717.0112.40	Ledex Switch Interlock Cap	7 EA	
8.	717.0112.50	Ledex Switch Interlock Plate	5 EA	
9.	717.0112.60	Ledex Switch Torsion Spring	5 EA	
10.	717.0112.70	Ledex Switch Compression Spring	2 EA	
11.	717.0112.80	Ledex Switch Back Plate	7 EA	
12.	717.0113.12	3/4 Square PB Switch Light Shield	8 EA	
13.	717.0113.13	3/4" Square PB Switch Clear Outcap	8 EA	
14.	717.0113.1491	White Ledex Lens Cap Insert	8 EA	
15.	717.0113.3210	Ledex 24 Volt Slide Base Bulb 20Ma	5 EA	LAMP: SW4-SW8
16.	717.0113.3314	Ledex 6Volt Slide Base Lamp 50Ma	2 EA	LAMP: SW1,SW2
17.	717.0114.10	Ledex Switch Mounting Block	2 EA	
18.	717.0114.50	Hex Head Module Mounting Screw	40 EA	
19.	717.0115.1080	8 Segment Ledex Mounting Channel	1 EA	
20.	717.0115.2020	2 Postion Ledex Interlock Bar	1 EA	
21.	717.0115.2050	5 Position Ledex Interlock Bar	1 EA	
22.	733.2207.0112	22 Ga 1 Condctr Brown Hook-Up Wire	.20 FT	
23.	738.0320.	20 Awg Solid Tinned Copper Wire	.10 FT	
24.	751.1506.5470	4.7K 1/2 Watt 5% Carbon Resistor	1 EA	R2
25.	751.1506.61	10K 1/2 Watt 5% Carbon Resistor	4 EA	R3-6
26.	751.2206.4220	220 R 2 Watt 5% Carbon Resistor	1 EA	R1

. . . continued on next page

TABLE 5-3 Parts List for 5184.234.0310
MXR-350 Ion Chamber Pkup & Dnsty Sw

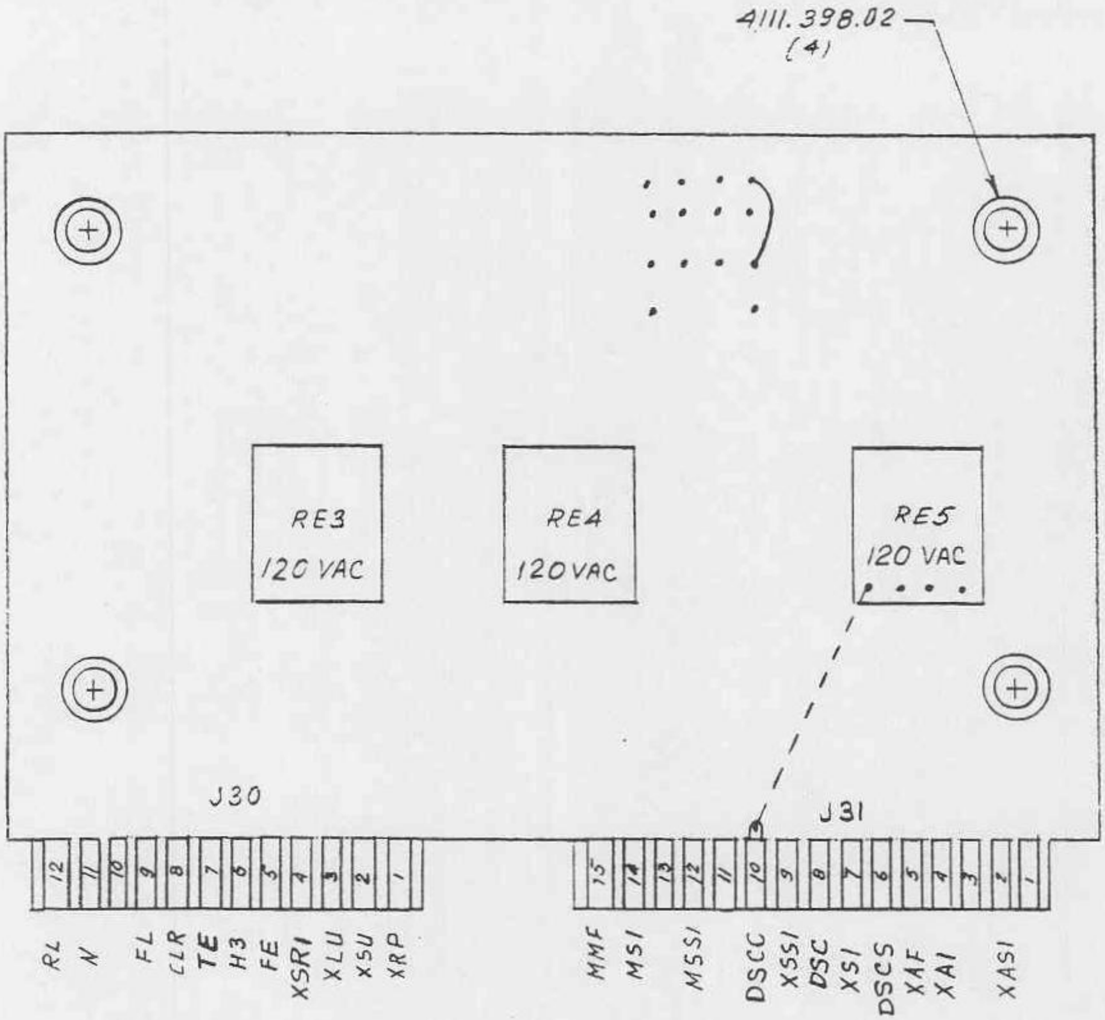
Part Number	Description	Quantity	Reference Designators
27. 782.1040.05	1N4005 1A 600V Silicon Rectifier	2 EA	D1,D2

TABLE 5-3 Parts List for 5184.234.0310
MXR-350 Ion Chamber Pkup & Dnsty Sw


J17 18 N
J17 9 RAB
J17 2 RAS
J17 8 12AT
R1
220/2W
D1
1N4005
D2
1N4005
6V LAMP
6V LAMP
J17 1 ATO
J17 4 ERE
J17 5 ERS
SW1
SPOT FILM
SW2
BUCKY
J17 6 EFO
1
2
3
4
5
K1
12VDC
J17 11 ERO
J17 13 DSCC
J17 14 DSH +12V
J17 17 24P
J17 15 DSL 0V
R2
4.7K/.5W
DENSITY SWITCHES
24V LAMP
SW4
+50%
SW5
+25%
SW6
NORMAL
SW7
-25%
SW8
-50%
R3
10K/.5W
R4
10K/.5W
R5
10K/.5W
R6
10K/.5W
10.7V
8.1V
5.4V
2.7V

MXR-350 ION CHAMBER PKUP & DENSITY

FIGURE 5-7 SCHEMATIC FOR 5184.234.0310

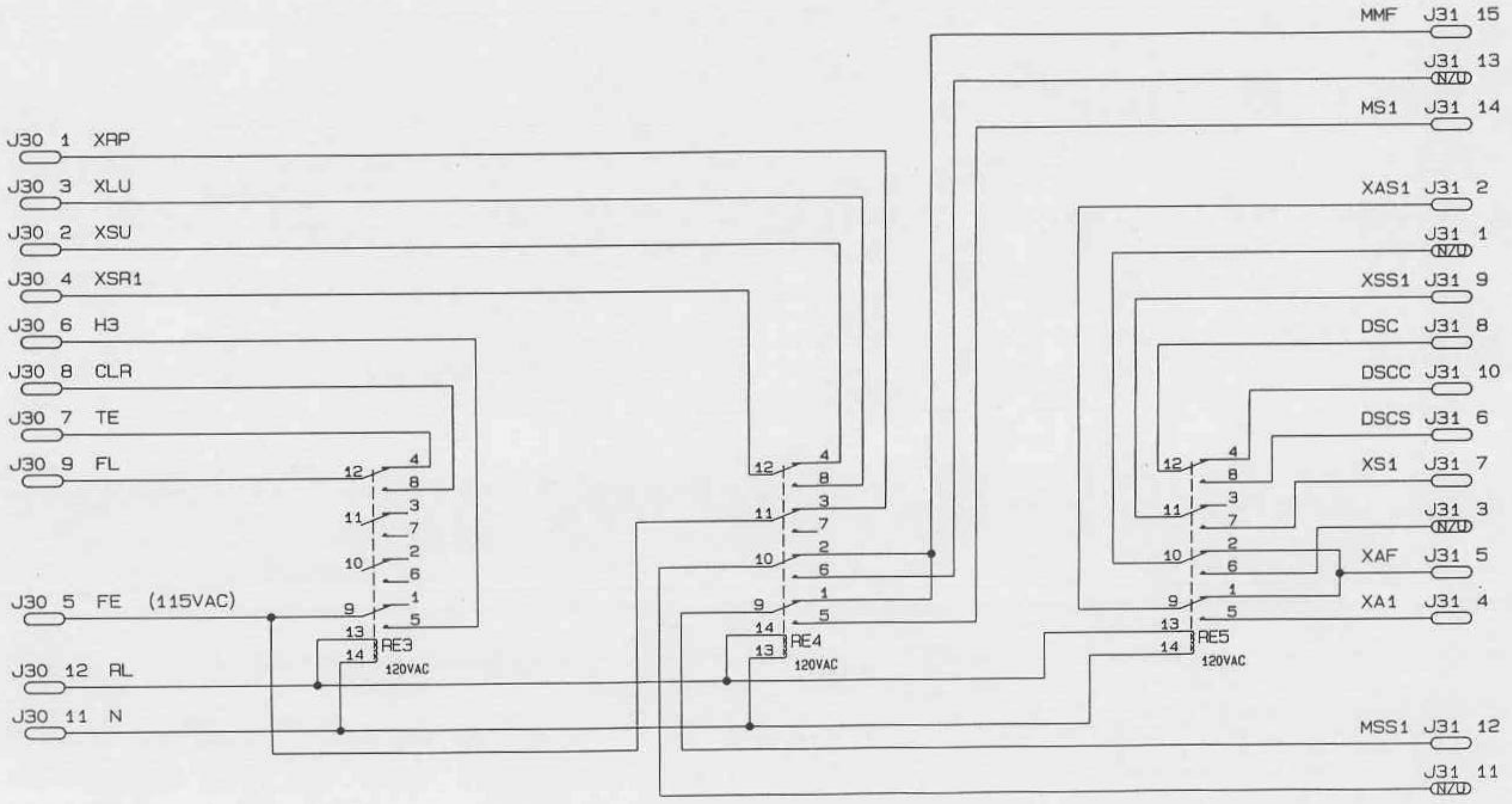

4111.398.02
(4)
RE3
120 VAC
RE4
120 VAC
RE5
120 VAC
J30
12
11
10
9
8
7
6
5
4
3
2
1
RL
N
FL
CLR
TE
H3
FE
XSRI
XLU
XSU
XRP
J31
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
MMF
MSI
MSSI
DSCC
XSSI
DSC
XSI
DSCS
XAF
XAI
XASI

MXR-350 SPOT FILM CHANGEOVER PCB

FIGURE 5-8 LAYOUT FOR 5184.234.0320

	Part Number	Description	Quantity	Reference Designators
1.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
3.	4184.234.0320	MXR-350 Spotfilm Changeover PC Blnk	1 EA	
4.	714.4371.1221	4PDT 120 Volt AC Mini Relay	3 EA	RE3,4,5
5.	714.9001.	4PDT Mini Relay Pc Socket	3 EA	
6.	714.9002.	Relay Hold-Down Spring	3 EA	
7.	733.2207.0151	22 Ga 1 Con 300v Green Hookup Wire	.30 FT	

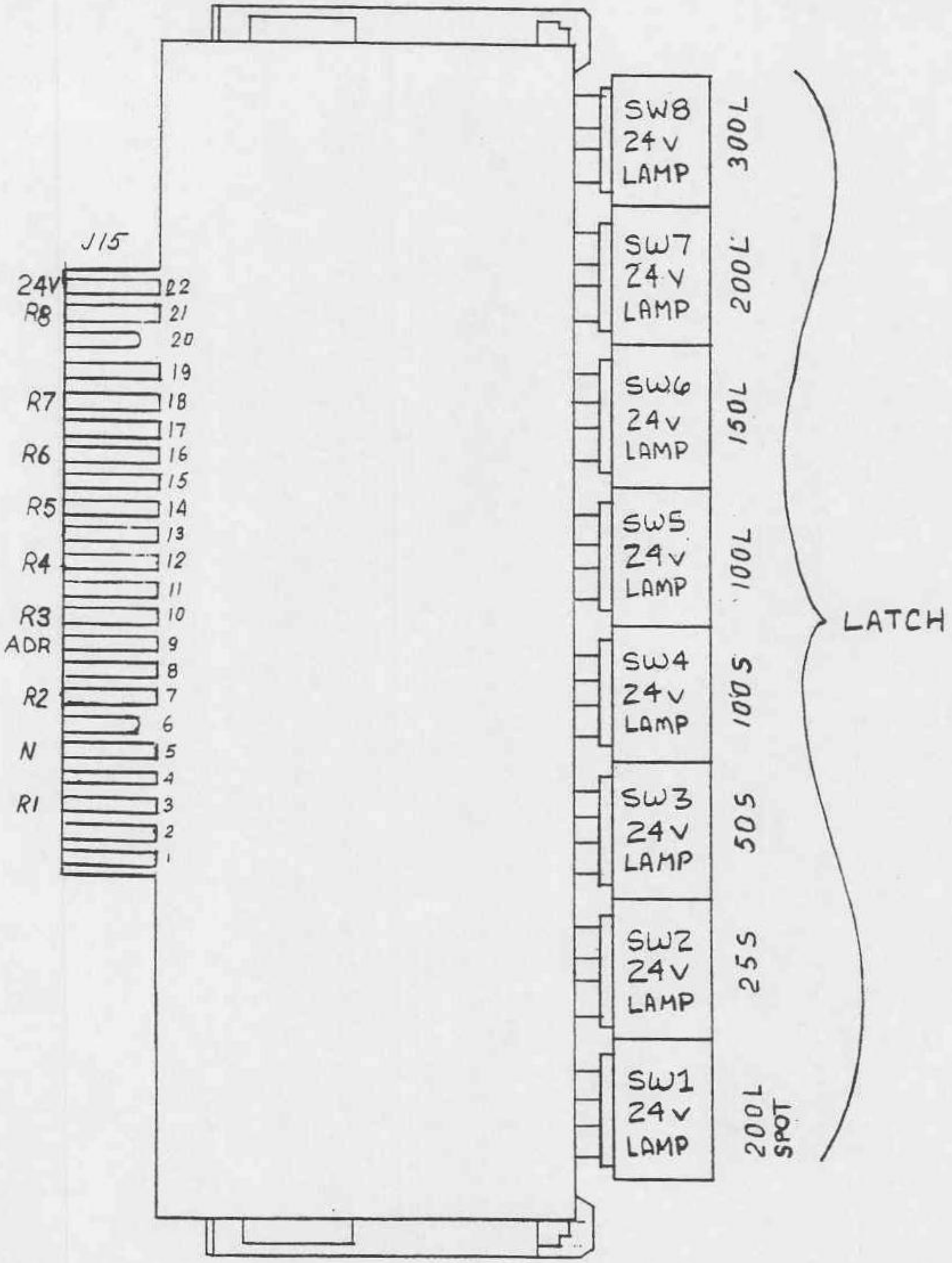
TABLE 5-4 Parts List for 5184.234.0320
MXR-350 Spotfilm Changeover Asm


J30 1 XRP
J30 3 XLU
J30 2 XSU
J30 4 XSR1
J30 6 H3
J30 8 CLR
J30 7 TE
J30 9 FL
J30 5 FE (115VAC)
J30 12 RL
J30 11 N
RE3
RE4
RE5
120VAC
12
11
10
9
13
14
4
8
3
7
2
6
1
5
MMF J31 15
J31 13 N/U
MS1 J31 14
XAS1 J31 2
J31 1 N/U
XSS1 J31 9
DSC J31 8
DSCC J31 10
DSCS J31 6
XS1 J31 7
J31 3 N/U
XAF J31 5
XA1 J31 4
MSS1 J31 12
J31 11 N/U

RL - 115VAC DURING SPOT FILM PREP

MXR-350 SPOT FILM CHANGEOVER PCB

FIGURE 5-9 SCHEMATIC FOR 5184.234.0320

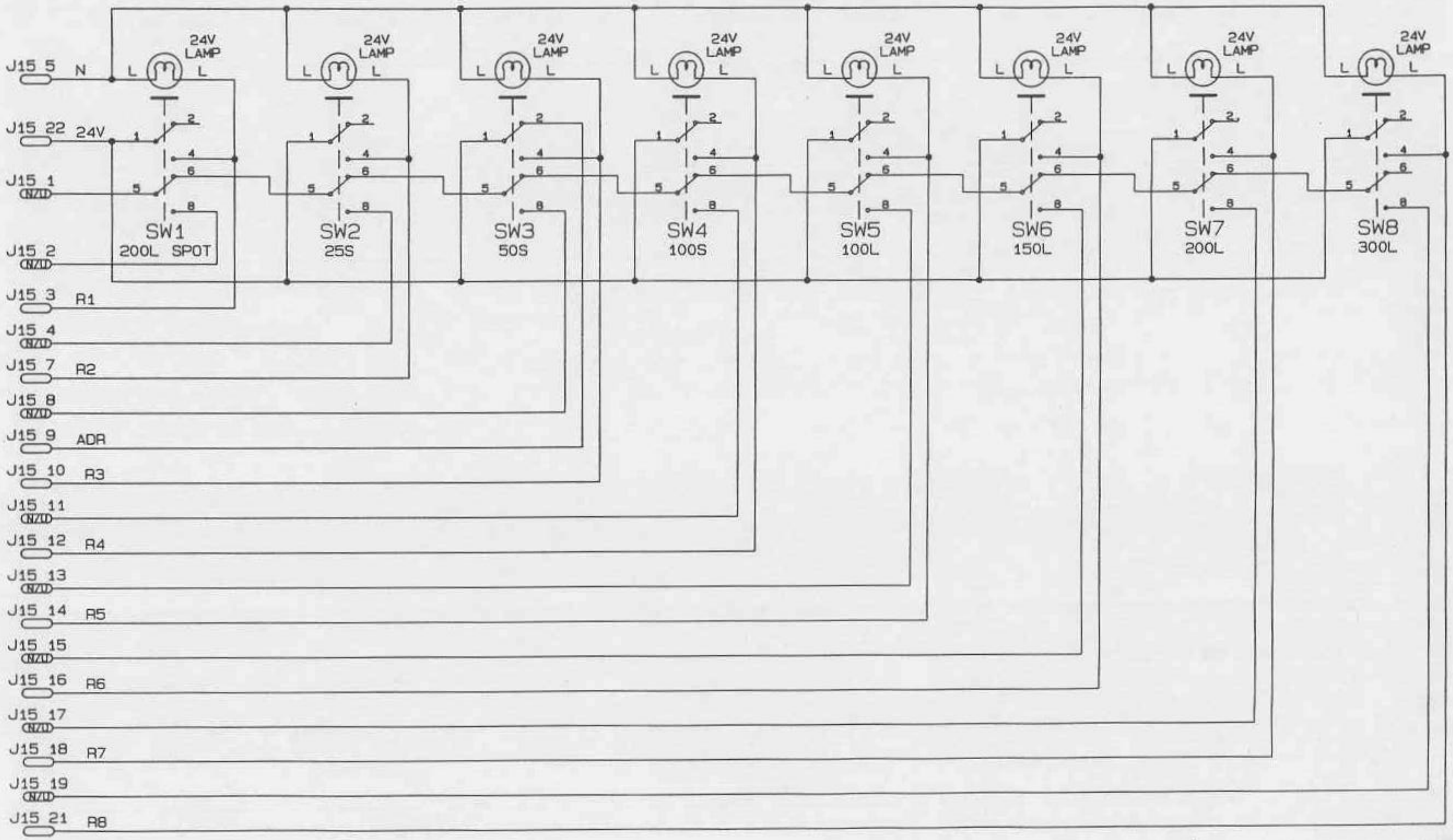

J15
24V
R8
R7
R6
R5
R4
R3
ADR
R2
N
R1
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
SW8 24V LAMP
300L
SW7 24V LAMP
200L
SW6 24V LAMP
150L
SW5 24V LAMP
100L
SW4 24V LAMP
100S
SW3 24V LAMP
50S
SW2 24V LAMP
25S
SW1 24V LAMP
200L SPOT
LATCH

MXR-350 mA TECH SELECT SWITCH ASM

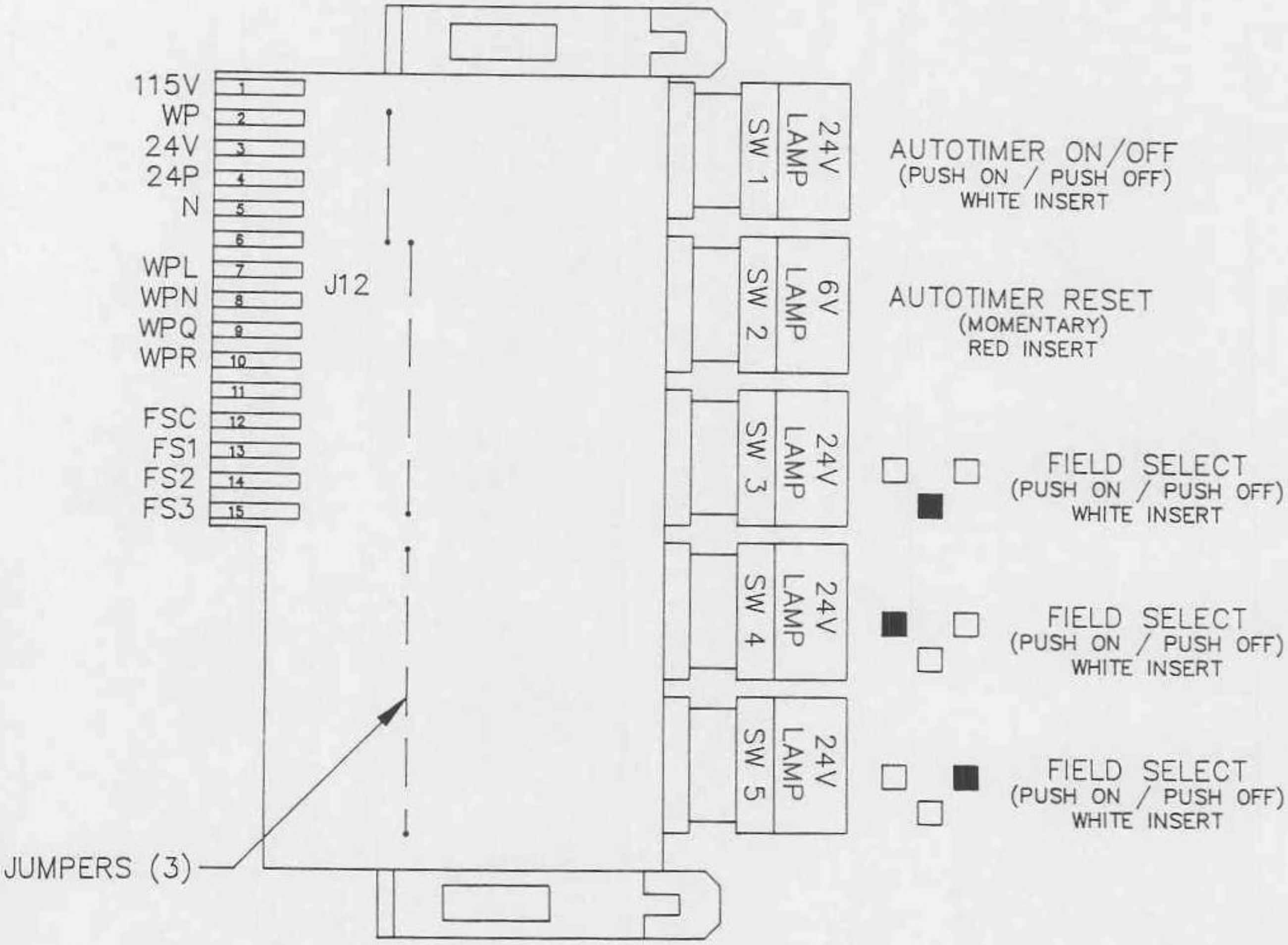
FIGURE 5-10 LAYOUT FOR 5184.234.04

Part Number	Description	Quantity	Reference Designators
1. 135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2. 4184.234.04	MXR-350 mA Select Switch PC Blank	1 EA	
3. 717.0113.12	3/4 Square PB Switch Light Shield	8 EA	
4. 717.0113.13	3/4" Square PB Switch Clear Outcap	8 EA	
5. 717.0113.1491	White Ledex Lens Cap Insert	8 EA	
6. 717.0113.3210	Ledex 24 Volt Slide Base Bulb 20Ma	8 EA	
7. 9281.223.01	8 Pushbuttn Reciprocal Latch Switch	1 EA	SW1-8

TABLE 5-5 Parts List for 5184.234.04
MXR-350 mA Tech Select Switch Asm


J15 5 N
J15 22 24V
J15 1
J15 2
J15 3 R1
J15 4
J15 7 R2
J15 8
J15 9 ADR
J15 10 R3
J15 11
J15 12 R4
J15 13
J15 14 R5
J15 15
J15 16 R6
J15 17
J15 18 R7
J15 19
J15 21 R8
24V LAMP
L
1
2
4
5
6
8
SW1 200L SPOT
SW2 25S
SW3 50S
SW4 100S
SW5 100L
SW6 150L
SW7 200L
SW8 300L

MXR-350 mA TECH SELECT SWITCH ASM
FIGURE 5-11 SCHEMATIC FOR 5184.234.04

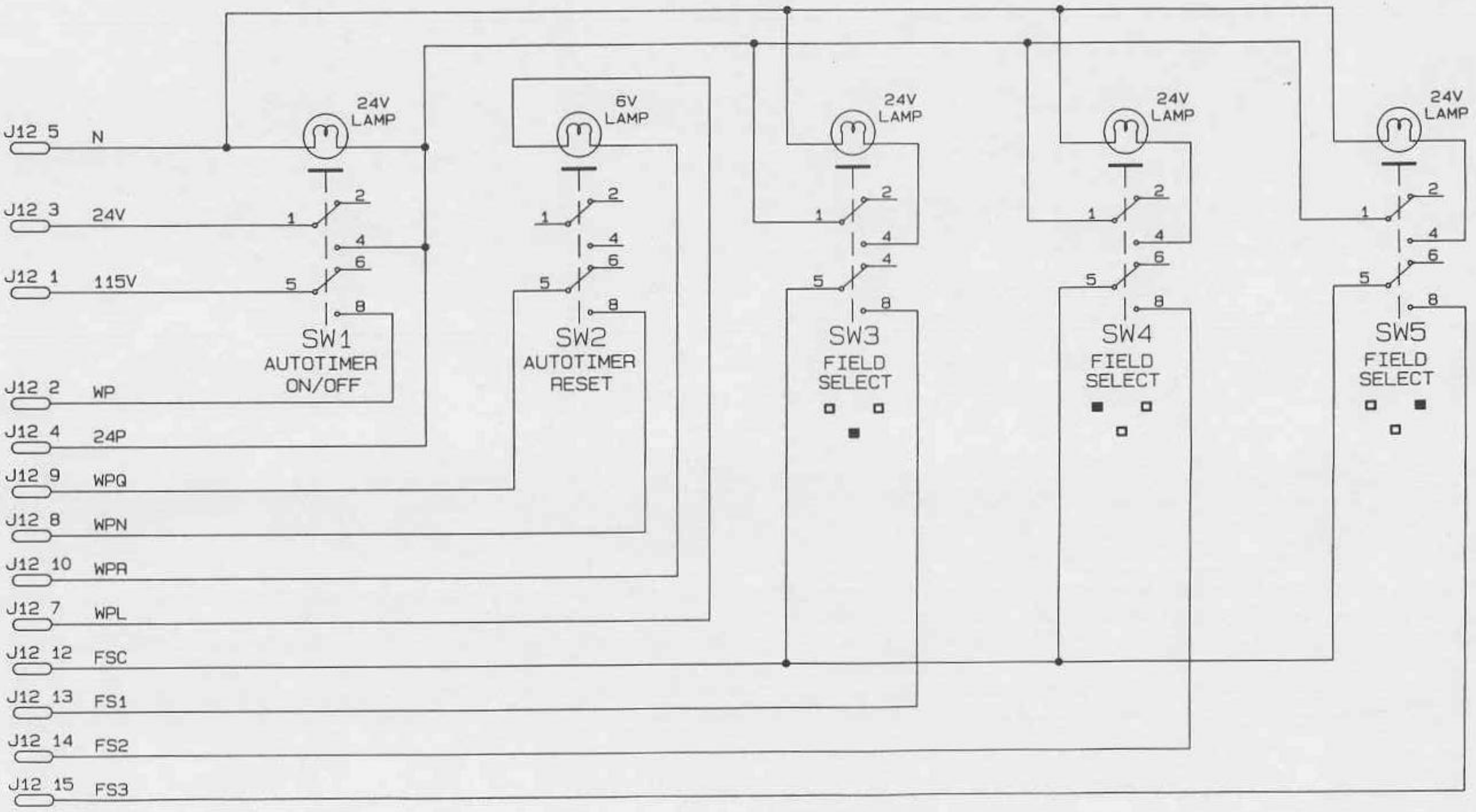

115V
WP
24V
24P
N
WPL
WPN
WPQ
WPR
FSC
FS1
FS2
FS3
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
J12
JUMPERS (3)
24V LAMP SW 1
6V LAMP SW 2
24V LAMP SW 3
24V LAMP SW 4
24V LAMP SW 5
AUTOTIMER ON/OFF
(PUSH ON / PUSH OFF)
WHITE INSERT
AUTOTIMER RESET
(MOMENTARY)
RED INSERT
FIELD SELECT
(PUSH ON / PUSH OFF)
WHITE INSERT
FIELD SELECT
(PUSH ON / PUSH OFF)
WHITE INSERT
FIELD SELECT
(PUSH ON / PUSH OFF)
WHITE INSERT

MXR-350 ION CHAMBER POWER-RESET-FIELD SWITCH

FIGURE 5-12 LAYOUT FOR 5184.234.0410

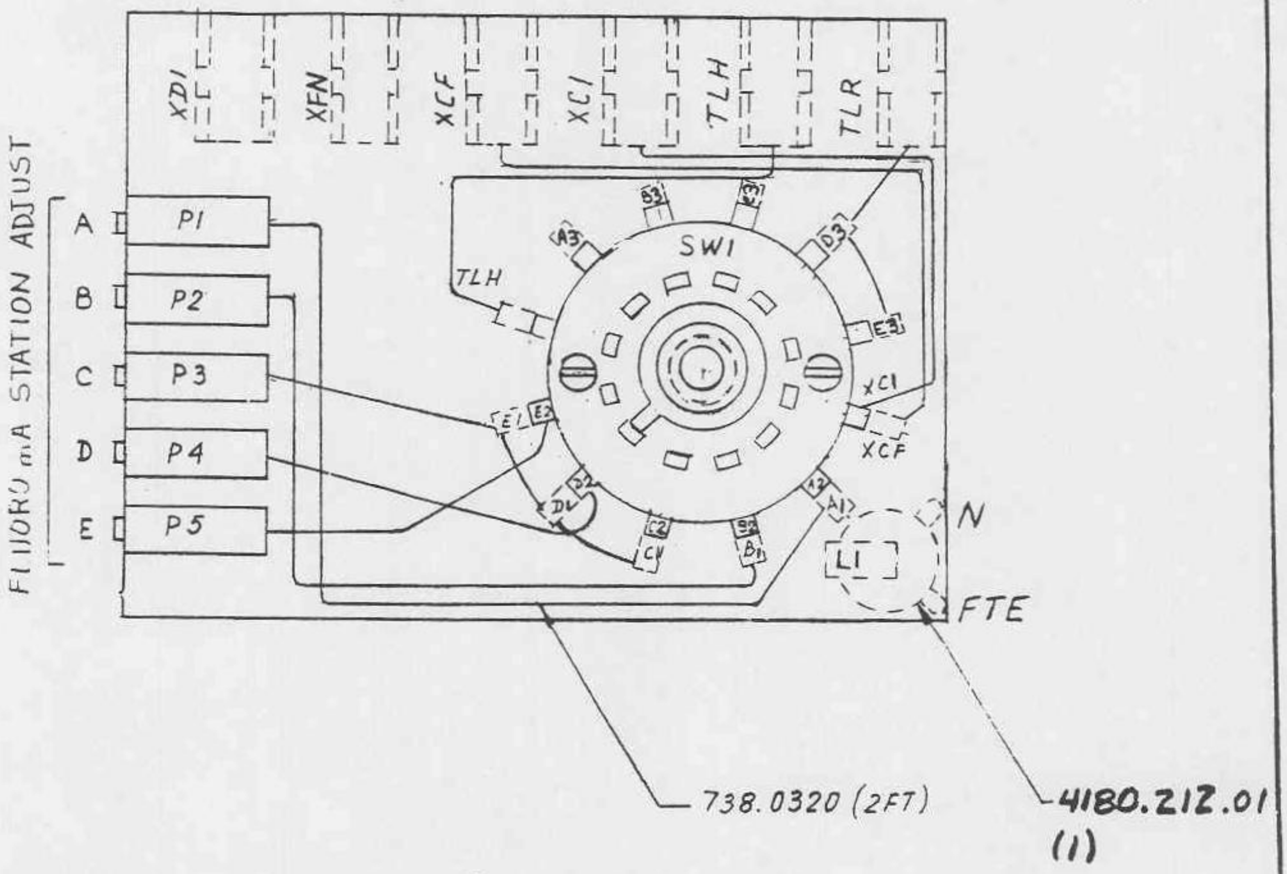
	Part Number	Description	Quantity	Reference Designators
1.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2.	4184.234.0410	MXR-350 Ion Chmbr Power Sw PC Blnk	1 EA	
3.	717.0111.30	Ledex Switch Module PC Terminal	5 EA	SW1-5
4.	717.0112.20	Ledex Maintain Plate	4 EA	
5.	717.0112.60	Ledex Switch Torsion Spring	4 EA	
6.	717.0112.80	Ledex Switch Back Plate	4 EA	
7.	717.0113.12	3/4 Square PB Switch Light Shield	5 EA	
8.	717.0113.13	3/4" Square PB Switch Clear Outcap	5 EA	
9.	717.0113.1420	Red Ledex Lens Cap Insert	1 EA	
10.	717.0113.1491	White Ledex Lens Cap Insert	4 EA	
11.	717.0113.3210	Ledex 24 Volt Slide Base Bulb 20Ma	4 EA	LAMP: SW1,SW3-5
12.	717.0113.3314	Ledex 6Volt Slide Base Lamp 50Ma	1 EA	LAMP: SW2
13.	717.0114.10	Ledex Switch Mounting Block	2 EA	
14.	717.0114.50	Hex Head Module Mounting Screw	28 EA	
15.	717.0115.1050	5 Segment Ledex Mounting Channel	1 EA	
16.	738.0320.	20 Awg Solid Tinned Copper Wire	.40 FT	

TABLE 5-6 Parts List for 5184.234.0410
MXR-350 Ion Chmbr Pwr-Reset-Fld Sw



J12 5 N
J12 3 24V
J12 1 115V
J12 2 WP
J12 4 24P
J12 9 WPQ
J12 8 WPN
J12 10 WPR
J12 7 WPL
J12 12 FSC
J12 13 FS1
J12 14 FS2
J12 15 FS3
24V LAMP
6V LAMP
SW1
AUTOTIMER
ON/OFF
SW2
AUTOTIMER
RESET
SW3
FIELD
SELECT
SW4
FIELD
SELECT
SW5
FIELD
SELECT
1
2
4
5
6
8

MXR-350 ION CHAMBER POWER-RESET-FIELD SWITCH
FIGURE 5-13 SCHEMATIC FOR 5184.234.0410

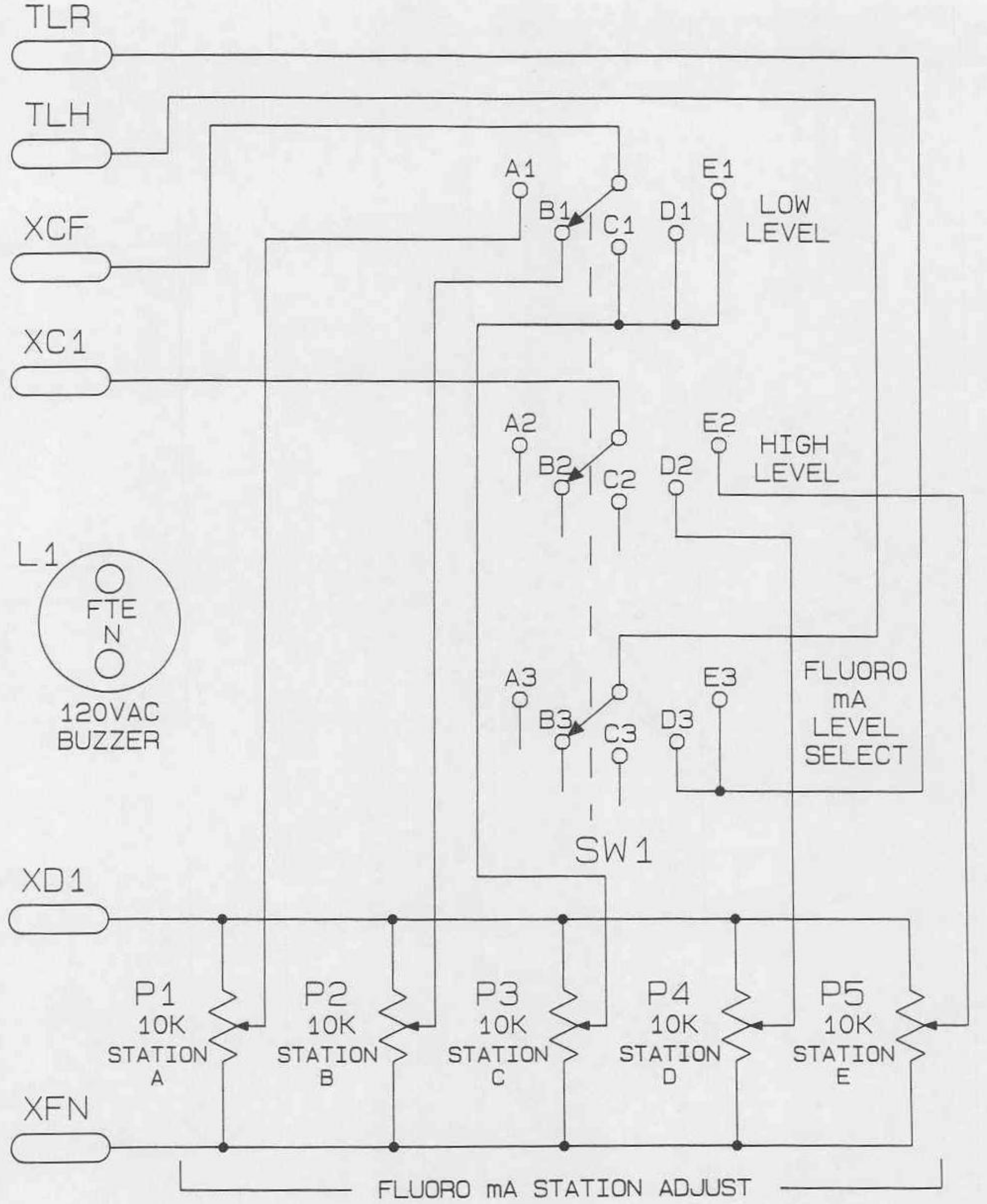

XD1
XFN
XCF
XC1
TLH
TLR
FLUORO mA STATION ADJUST
A
B
C
D
E
P1
P2
P3
P4
P5
SW1
TLH
A3
B3
C3
D3
E3
XC1
XCF
E1
E2
D2
D1
C2
C1
B2
B1
A2
A1
L1
N
FTE
738.0320 (2FT)
4180.212.01
(1)

MXR-350 FLUORO mA CONTROL BOARD ASM

FIGURE 5-14 LAYOUT FOR 5184.234.0501

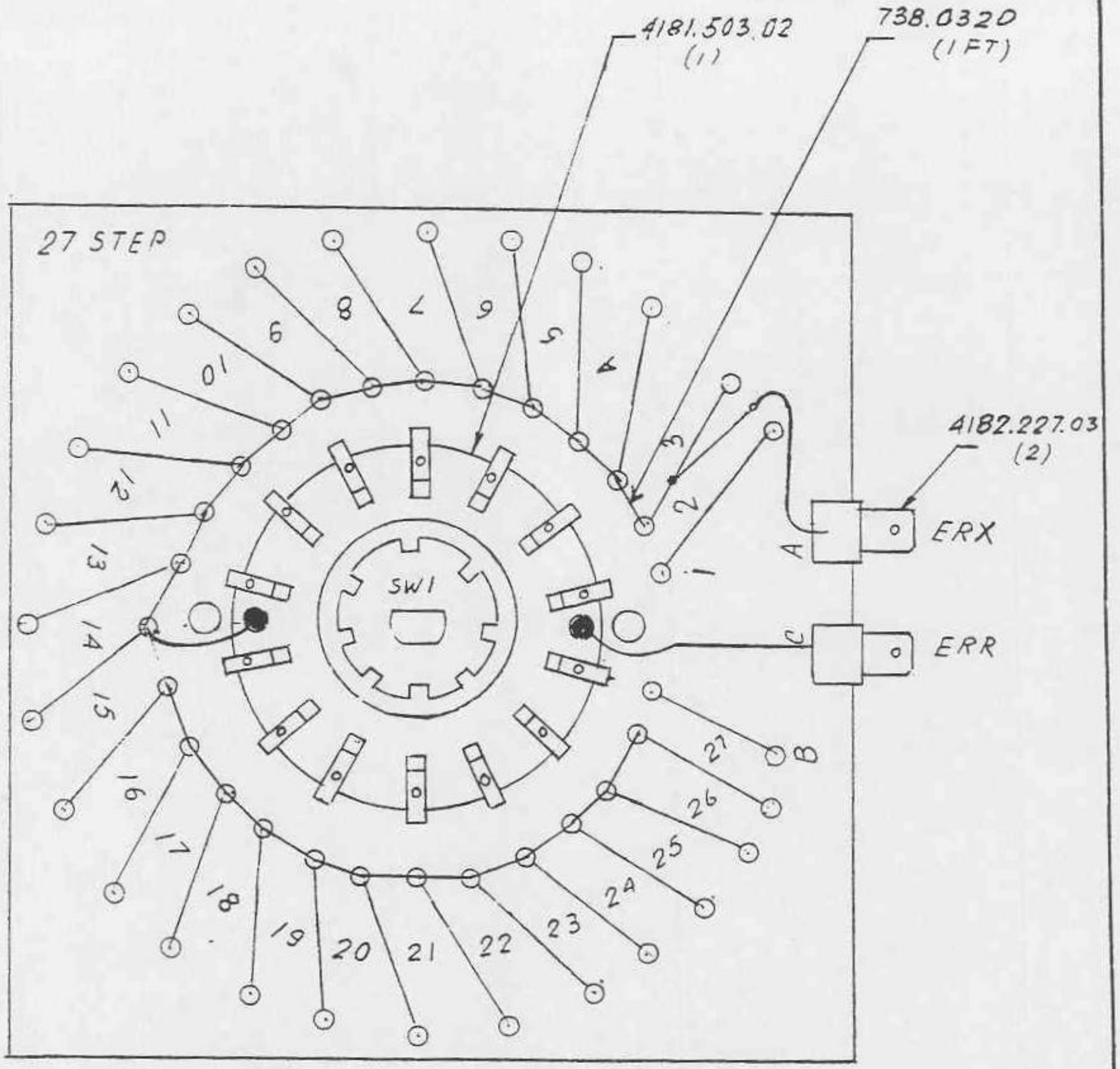
	Part Number	Description	Quantity	Reference Designators
1.	121.0632.0617	6-32 X 3/8 Round Steel Philps Screw	1 EA	
2.	123.6060.20	#6 Internal Tooth Steel Lockwasher	1 EA	
3.	129.5120.6511	1/8 X 3/16 Brass Eyelet	12 EA	
4.	135.3416.01	#16 Teflon Insulating Tubing	2 FT	
5.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
6.	4155.222.15	5/16 Inch Spacer	6 EA	
7.	4180.212.01	120 Volt Ac 60 Hz Buzzer	1 EA	L1
8.	4182.132.12	4-Way Tab Terminal	6 EA	
9.	4182.223.03	4P5T 2 Sctn Ns Rotary Sw Shaft Asm	1 EA	SW1
10.	4184.234.0501	MXR-350 Fluoro mA Control PC Blank	1 EA	
11.	738.0320.	20 Awg Solid Tinned Copper Wire	2.40 FT	
12.	754.1756.1007	3/4W 10K 15T Cermet Trim Pot	5 EA	P1-P5

TABLE 5-7 Parts List for 5184.234.0501
MXR-350 Fluoro mA Control Board Asm


TLR
TLH
XCF
XC1
A1
B1
C1
D1
E1
LOW LEVEL
A2
B2
C2
D2
E2
HIGH LEVEL
L1
FTE
N
120VAC BUZZER
A3
B3
C3
D3
E3
FLUORO mA LEVEL SELECT
SW1
XD1
P1 10K STATION A
P2 10K STATION B
P3 10K STATION C
P4 10K STATION D
P5 10K STATION E
XFN
FLUORO mA STATION ADJUST

FLUORO MA CONTROL BOARD ASM

FIGURE 5-15 SCHEMATIC FOR 5184.234.0501

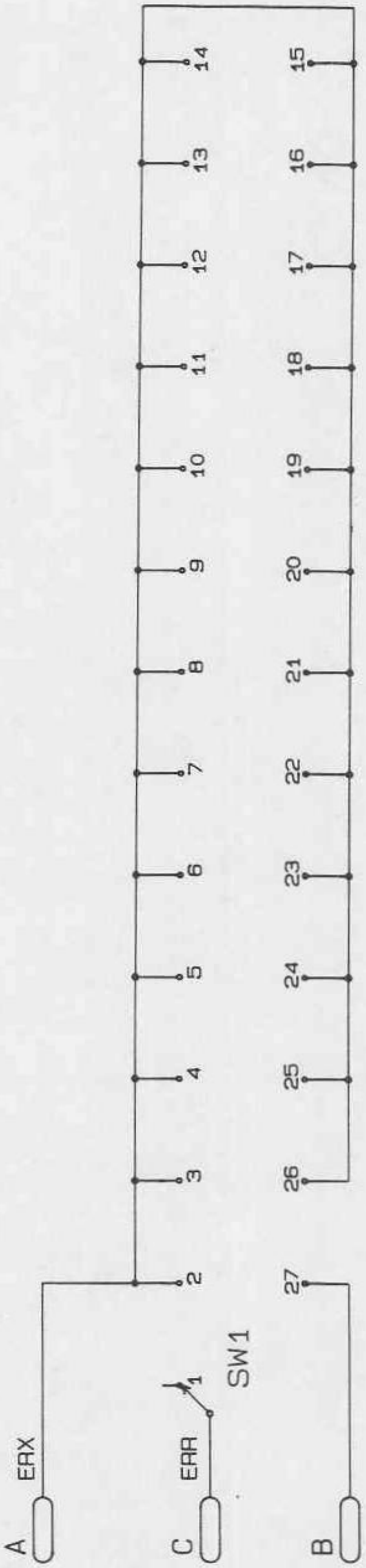

4181.503.02
(1)
738.0320
(1FT)
4182.227.03
(2)
27 STEP
SW1
ERX
ERR
A
B
C
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

MXR-350 TIMER SAFETY SWITCH ASM

FIGURE 5-16 LAYOUT FOR 5184.234.06

	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	2 EA	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4181.503.02	27 Step Shorting Switch Deck	1 EA	SW1
4.	4182.227.03	Tab Terminal	2 EA	
5.	4184.234.06	MXR-350 Timer Safety Switch PC Blnk	1 EA	
6.	738.0320.	20 Awg Solid Tinned Copper Wire	1 FT	

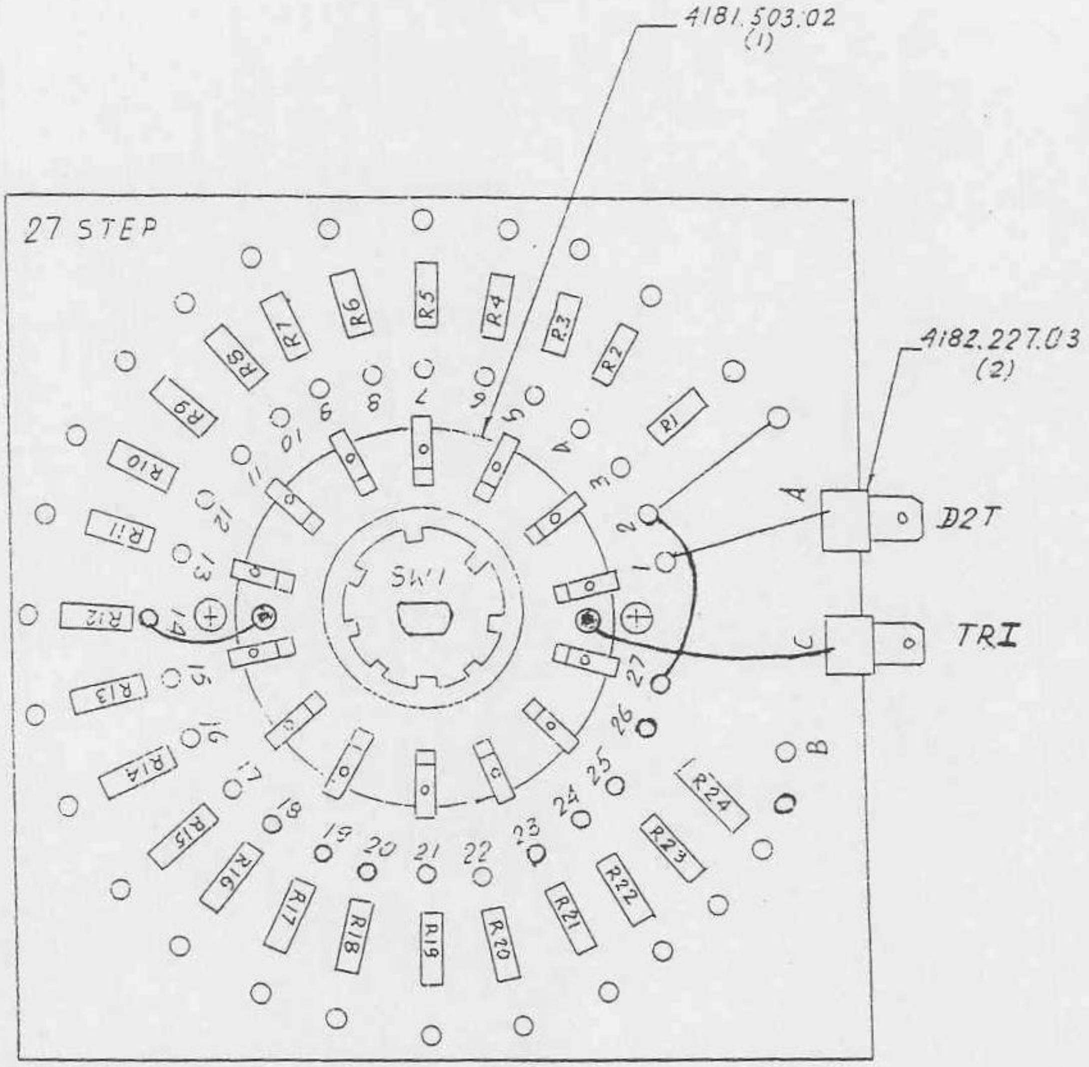
TABLE 5-8 Parts List for 5184.234.06
MXR-350 Timer Safety Switch Asm


14
15
13
16
12
17
11
18
10
19
9
20
8
21
7
22
6
23
5
24
4
25
3
26
2
27
1
SW1
ERX
ERR
A
C
B

FOR ASSEMBLY DRAWING
SEE 5184.234.06

MXR-350 TIMER SAFETY SWITCH ASM

FIGURE 5-17 SCHEMATIC FOR 5184.234.06

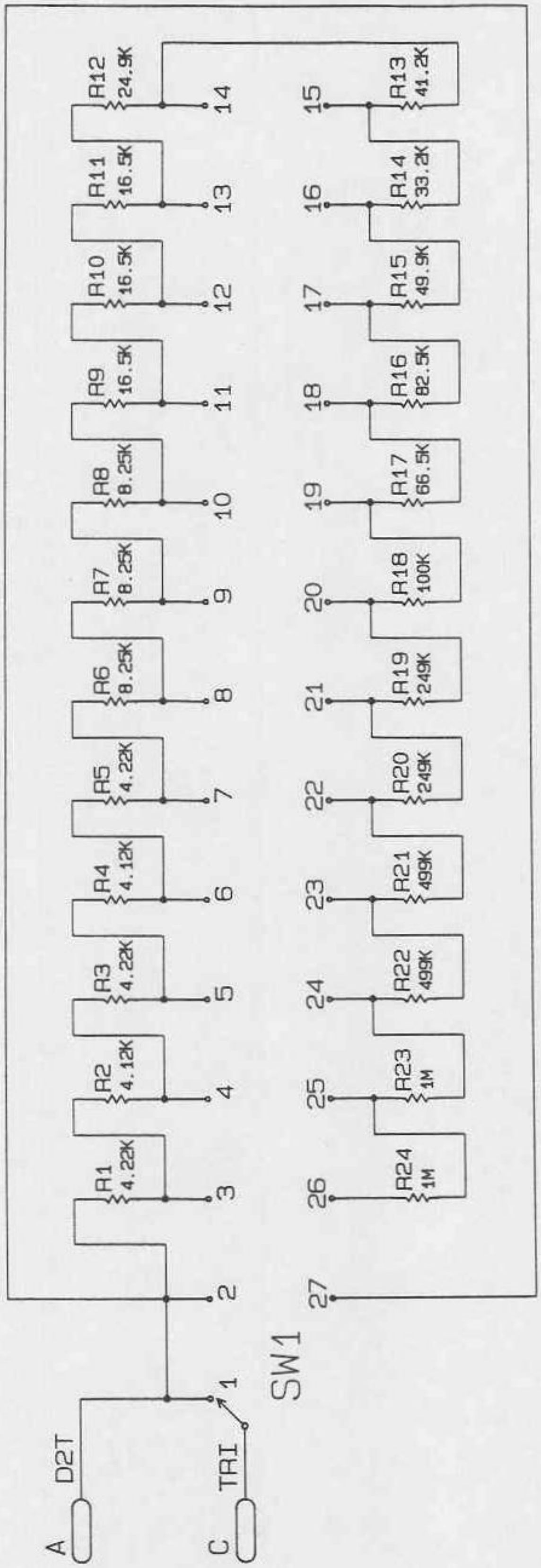

27 STEP
4181.503.02
(1)
4182.227.03
(2)
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
SW1
A
C
B
D2T
TRI
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

MXR-350 60 Hz IMPULSE TIMER RSTR ASM

FIGURE 5-18 LAYOUT FOR 5184.234.0601

	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	2 EA	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4181.503.02	27 Step Shorting Switch Deck	1 EA	SW1
4.	4182.227.03	Tab Terminal	2 EA	
5.	4184.234.0601	Mil 60Hz Impulse Tmr Resistor Blnk	1 EA	
6.	733.2207.0121	22 Ga 1 Con 300v Red Hookup Wire	.10 FT	
7.	738.0320.	20 Awg Solid Tinned Copper Wire	.30 FT	
8.	751.1504.5412	4.12K 1/2 Watt 1% Carbon Resistor	2 EA	R2,4
9.	751.1504.5422	4.22K 1/2 Watt 1% Carbon Resistor	3 EA	R1,3,5
10.	751.1504.5825	8.25K 1/2 Watt 1% Carbon Resistor	3 EA	R6,7,8
11.	751.1504.6165	16.5K 1/2 Watt 1% Carbon Resistor	3 EA	R9,10,11
12.	751.1504.6249	24.9K 1/2 Watt 1% Carbon Resistor	1 EA	R12
13.	751.1504.6332	33.2K 1/2 Watt 1% Carbon Resistor	1 EA	R14
14.	751.1504.6412	41.2K 1/2 Watt 1% Carbon Resistor	1 EA	R13
15.	751.1504.6499	49.9K 1/2 Watt 1% Carbon Resistor	1 EA	R15
16.	751.1504.6665	66.5K 1/2 Watt 1% Carbon Resistor	1 EA	R17
17.	751.1504.6825	82.5K 1/2 Watt 1% Carbon Resistor	1 EA	R16
18.	751.1504.71	100K 1/2 Watt 1% Carbon Resistor	1 EA	R18
19.	751.1504.7249	249K 1/2 Watt 1% Carbon Resistor	2 EA	R19,20
20.	751.1504.7499	499K 1/2 Watt 1% Carbon Resistor	2 EA	R21,22
21.	751.1504.81	1M 1/2 Watt 1% Carbon Resistor	2 EA	R23,24

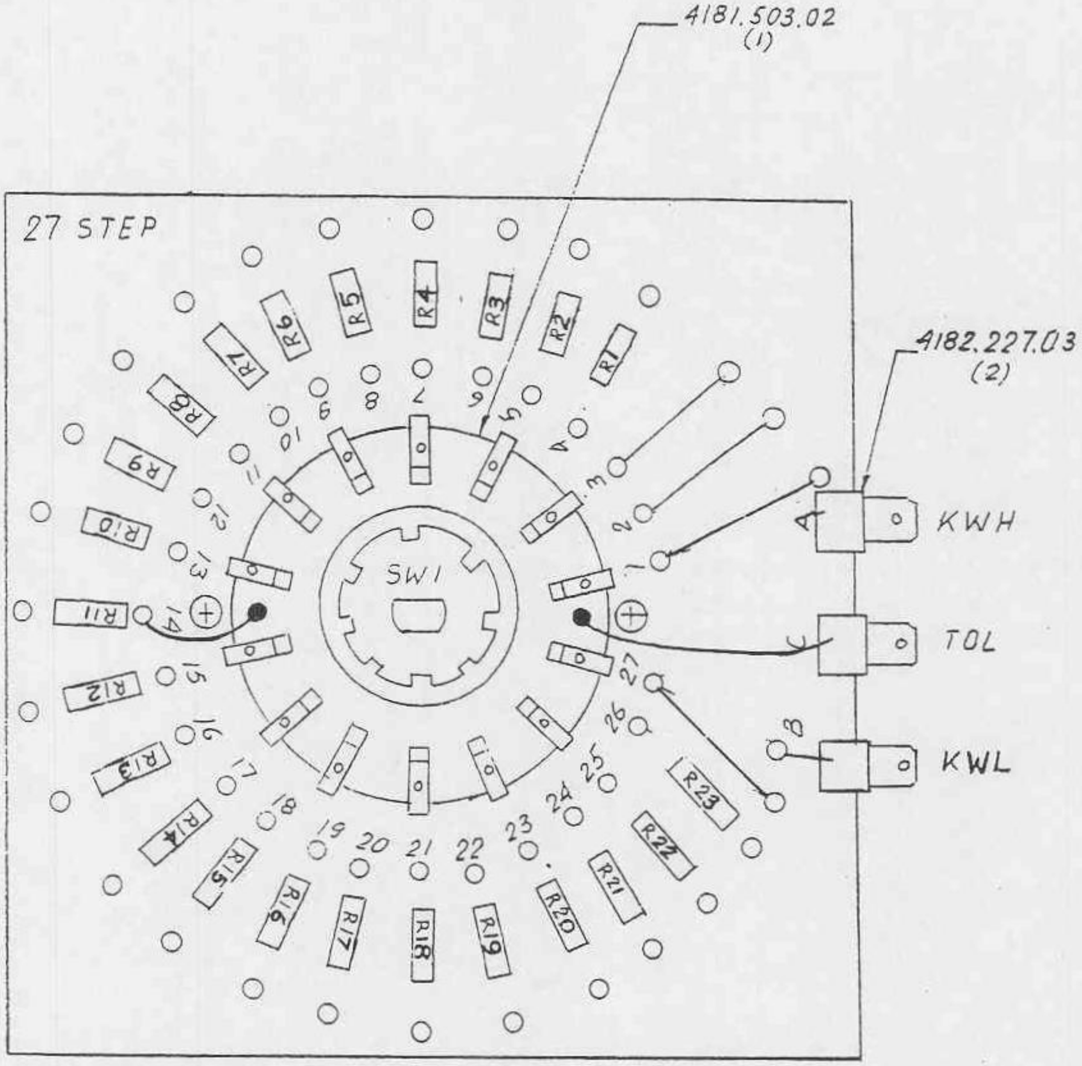
TABLE 5-9 Parts List for 5184.234.0601
Mil.60Hz Impulse Timer Resistor Asm


R1 4.22K
R2 4.12K
R3 4.22K
R4 4.12K
R5 4.22K
R6 8.25K
R7 8.25K
R8 8.25K
R9 16.5K
R10 16.5K
R11 16.5K
R12 24.9K
R13 41.2K
R14 33.2K
R15 49.9K
R16 82.5K
R17 66.5K
R18 100K
R19 249K
R20 249K
R21 499K
R22 499K
R23 1M
R24 1M
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
SW1
D2T
TRI
A
C

ALL RESISTORS
ARE 1/2W, 1%

MXR-350 60 HZ IMPULSE TIMER RSTR ASM

FIGURE 5-19 SCHEMATIC FOR 5184.234.0601

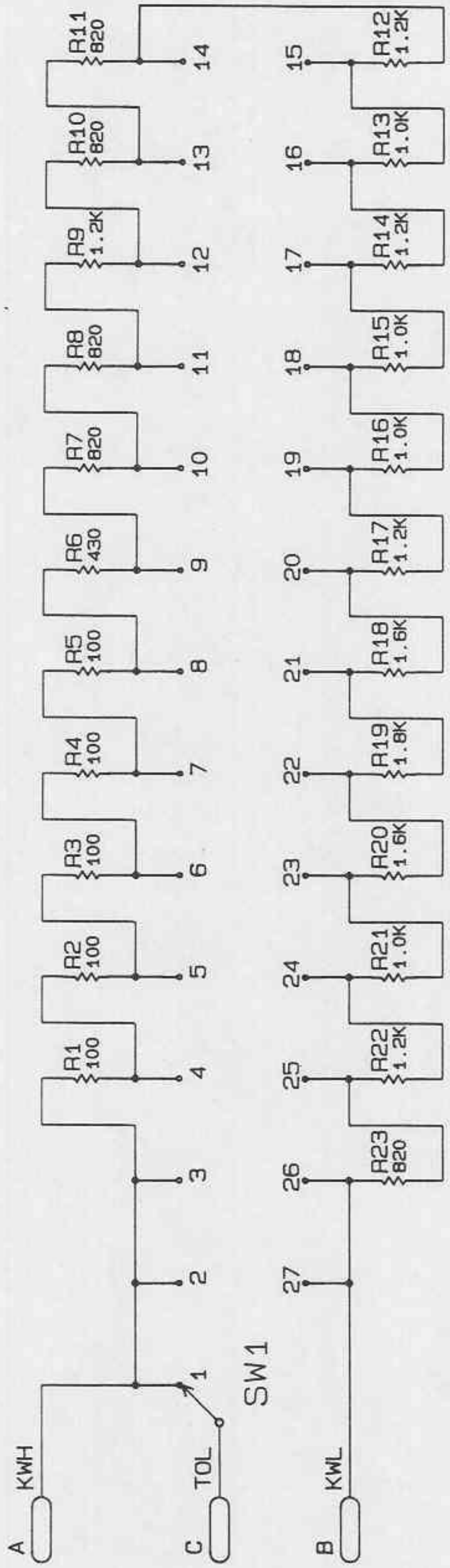

4181.503.02
(1)
4182.227.03
(2)
27 STEP
SW1
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
A
B
C
KWH
TOL
KWL
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

MXR-350 UNIVERSAL TOLA RESISTOR ASM
FIGURE 5-20 LAYOUT FOR 5184.234.0690

	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	3 EA	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4181.503.02	27 Step Shorting Switch Deck	1 EA	SW1
4.	4182.227.03	Tab Terminal	3 EA	
5.	4184.234.069	MXR-350 Univ TOLA Resistor PC Blank	1 EA	
6.	738.0320.	20 Awg Solid Tinned Copper Wire	.30 FT	
7.	751.1256.41	100 Ohm 1/4 Watt 5% Carbon Resistor	5 EA	R1,R2,R3,R4,R5
8.	751.1256.4430	430 Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R6
9.	751.1256.4820	820 Ohm 1/4 Watt 5% Carbon Resistor	5 EA	R7,R8,R10,R11,R23
10.	751.1256.51	1.0K 1/4 Watt 5% Carbon Resistor	4 EA	R13,R15,R16,R21
11.	751.1256.5120	1.2K 1/4 Watt 5% Carbon Resistor	5 EA	R9,R12,R14,R17,R22
12.	751.1256.5160	1.6K 1/4 Watt 5% Carbon Resistor	2 EA	R18,R20
13.	751.1256.5180	1.8K 1/4 Watt 5% Carbon Ressitor	1 EA	R19

TABLE 5-10 Parts List for 5184.234.0690
MXR-350 Universal TOLA Resistor Asm

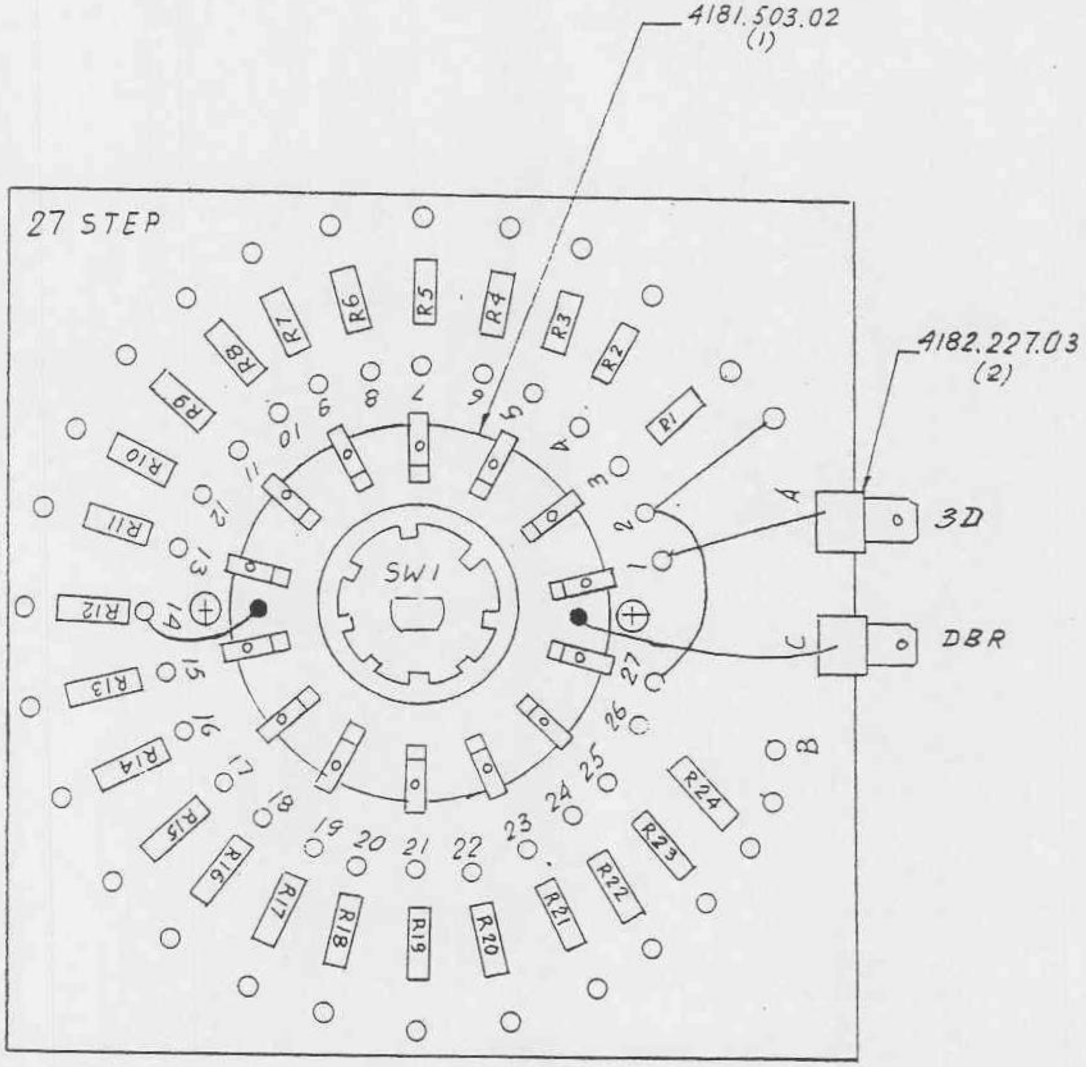
ALL RESISTORS
ARE 1/4W, 5%



R11 820
R10 820
R9 1.2K
R8 820
R7 820
R6 430
R5 100
R4 100
R3 100
R2 100
R1 100
R12 1.2K
R13 1.0K
R14 1.2K
R15 1.0K
R16 1.0K
R17 1.2K
R18 1.6K
R19 1.8K
R20 1.6K
R21 1.0K
R22 1.2K
R23 820
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
SW1
A
KWH
C
TOL
B
KWL

MXR-350 UNIVERSAL TOLA RESISTOR ASM

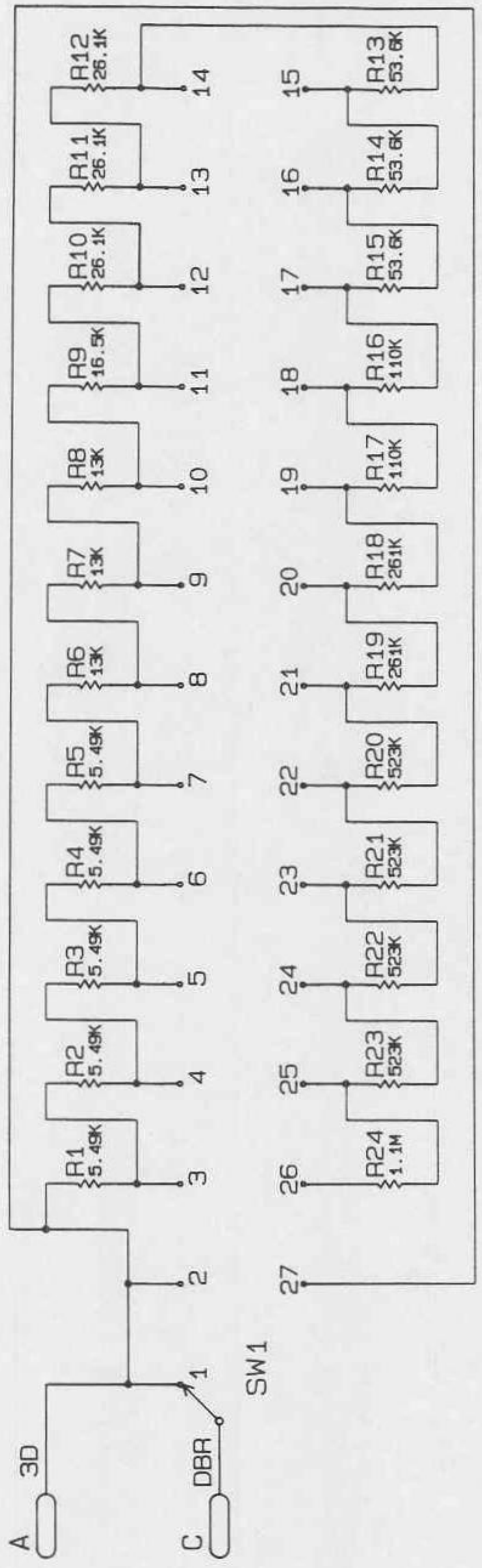
FIGURE 5-21 SCHEMATIC FOR 5184.234.0690


27 STEP
4181.503.02
(1)
4182.227.03
(2)
A
3D
C
DBR
B
SW1
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

MXR-350 UNIVERSAL BACKUP TIMER RESISTOR ASM
FIGURE 5-22 LAYOUT FOR 5184.234.0698

	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	2 EA	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4181.503.02	27 Step Shorting Switch Deck	1 EA	SW1
4.	4182.227.03	Tab Terminal	2 EA	
5.	4184.234.0698	MXR-350 Backup Timer Resistor Blank	1 EA	
6.	733.2207.0121	22 Ga 1 Con 300v Red Hookup Wire	.10 FT	
7.	738.0320.	20 Awg Solid Tinned Copper Wire	.30 FT	
8.	751.1504.5549	5.49K 1/2 Watt 1% Carbon Resistor	5 EA	R1,2,3,4,5
9.	751.1504.6130	13.0k 1/2 Watt 1% Carbon Resistor	3 EA	R6,7,8
10.	751.1504.6165	16.5K 1/2 Watt 1% Carbon Resistor	1 EA	R9
11.	751.1504.6261	26.1K 1/2 Watt 1% Carbon Resistor	3 EA	R10,11,12
12.	751.1504.6536	53.6K 1/2 Watt 1% Carbon Resistor	3 EA	R13,14,15
13.	751.1504.7110	110K 1/2 Watt 1% Carbon Resistor	2 EA	R16,17
14.	751.1504.7261	261K 1/2 Watt 1% Carbon Resistor	2 EA	R18,19
15.	751.1504.7523	523K 1/2 Watt 1% Carbon Resistor	4 EA	R20,21,22,23
16.	751.1504.8110	1.10M 1/2 Watt 1% Carbon Resistor	1 EA	R24

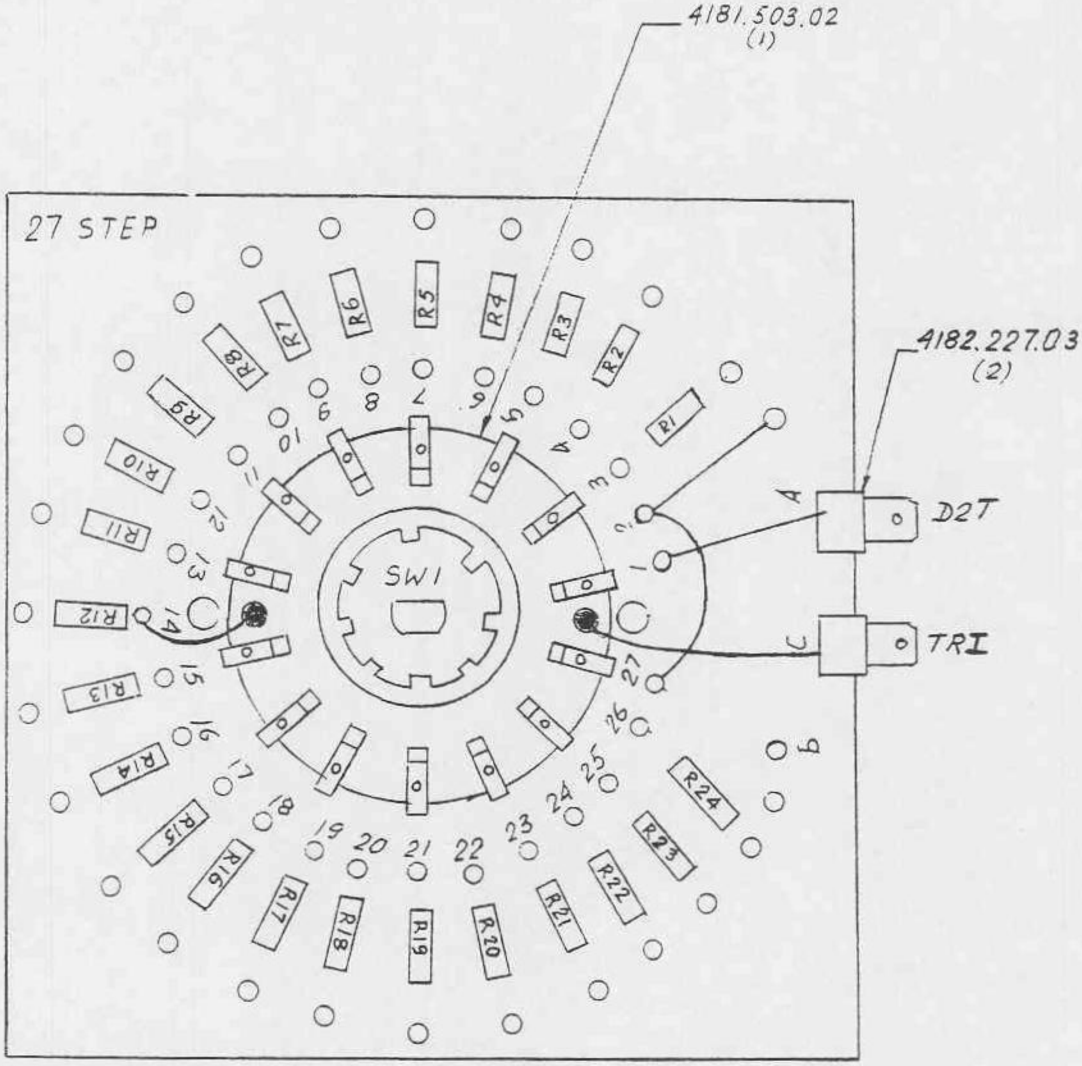
TABLE 5-11 Parts List for 5184.234.0698
MXR-350 Backup Timer Resistor Asm


A
3D
C
DBR
SW1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
R1 5.49K
R2 5.49K
R3 5.49K
R4 5.49K
R5 5.49K
R6 13K
R7 13K
R8 13K
R9 16.5K
R10 26.1K
R11 26.1K
R12 26.1K
R13 53.6K
R14 53.6K
R15 53.6K
R16 110K
R17 110K
R18 261K
R19 261K
R20 523K
R21 523K
R22 523K
R23 523K
R24 1.1M

ALL RESISTORS
ARE 1/2W, 1%

MXR-350 BACKUP TIMER RESISTOR ASM

FIGURE 5-23 SCHEMATIC FOR 5184.234.0698

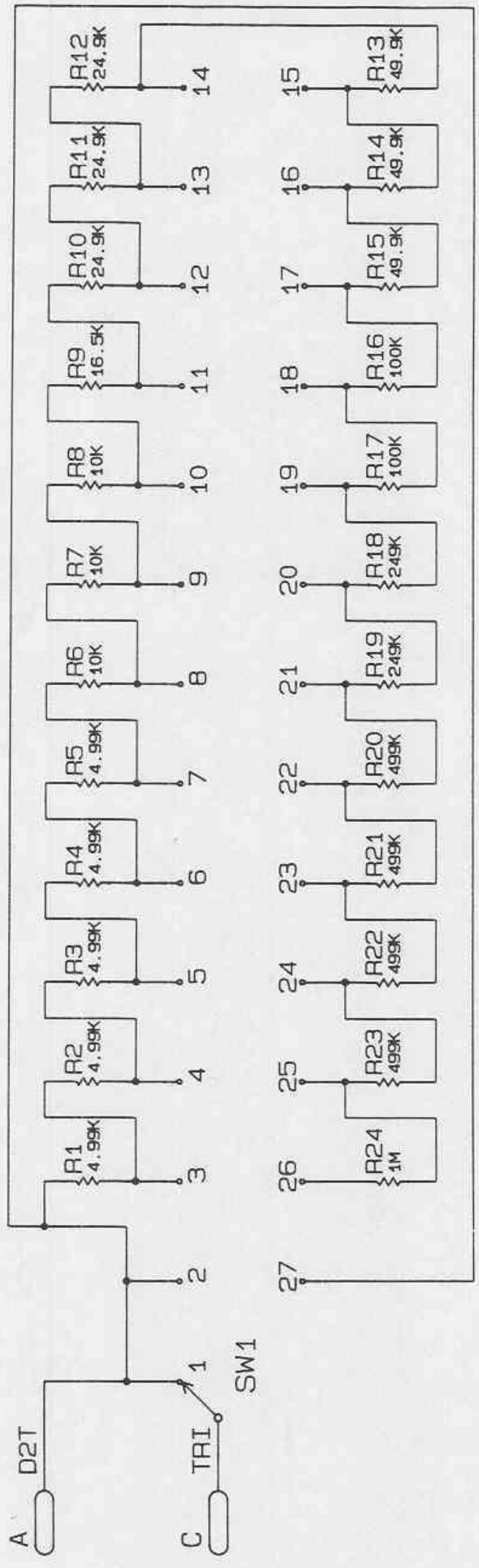

4181.503.02
(1)
4182.227.03
(2)
27 STEP
SW1
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
A
C
D2T
TRI

MXR-350 50 Hz IMPULSE TIMER RESISTOR ASM

FIGURE 5-24 LAYOUT FOR 5184.234.0699

	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	2 EA	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4181.503.02	27 Step Shorting Switch Deck	1 EA	SW1
4.	4182.227.03	Tab Terminal	2 EA	
5.	4184.234.0699	50Hz Impulse Tmr Resistor Blnk -Mil	1 EA	
6.	733.2207.0121	22 Ga 1 Con 300v Red Hookup Wire	.10 FT	
7.	738.0320.	20 Awg Solid Tinned Copper Wire	.30 FT	
8.	751.1504.5499	4.99K 1/2 Watt 1% Carbon Resistor	5 EA	R1,2,3,4,5
9.	751.1504.61	10.0K 1/2 Watt 1% Carbon Resistor	3 EA	R6,7,8
10.	751.1504.6165	16.5K 1/2 Watt 1% Carbon Resistor	1 EA	R9
11.	751.1504.6249	24.9K 1/2 Watt 1% Carbon Resistor	3 EA	R10,11,12
12.	751.1504.6499	49.9K 1/2 Watt 1% Carbon Resistor	3 EA	R13,14,15
13.	751.1504.71	100K 1/2 Watt 1% Carbon Resistor	2 EA	R16,17
14.	751.1504.7249	249K 1/2 Watt 1% Carbon Resistor	2 EA	R18,19
15.	751.1504.7499	499K 1/2 Watt 1% Carbon Resistor	4 EA	R20,21,22,23
16.	751.1504.81	1M 1/2 Watt 1% Carbon Resistor	1 EA	R24

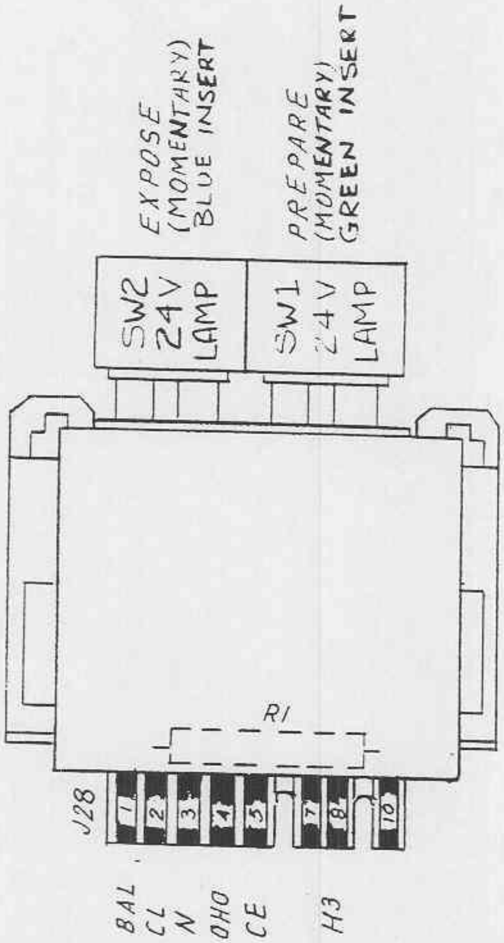
TABLE 5-12 Parts List for 5184.234.0699
Mil.50Hz Impulse Timer Resistor Asm


R1 4.99K
R2 4.99K
R3 4.99K
R4 4.99K
R5 4.99K
R6 10K
R7 10K
R8 10K
R9 16.5K
R10 24.9K
R11 24.9K
R12 24.9K
R13 49.9K
R14 49.9K
R15 49.9K
R16 100K
R17 100K
R18 249K
R19 249K
R20 499K
R21 499K
R22 499K
R23 499K
R24 1M
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
SW1
D2T
TRI
A
C

ALL RESTORS
ARE 1/2W, 1%

MXR-350 50 HZ IMPULSE TIMER RESISTOR ASM

FIGURE 5-25 SCHEMATIC FOR 5184.234.0699

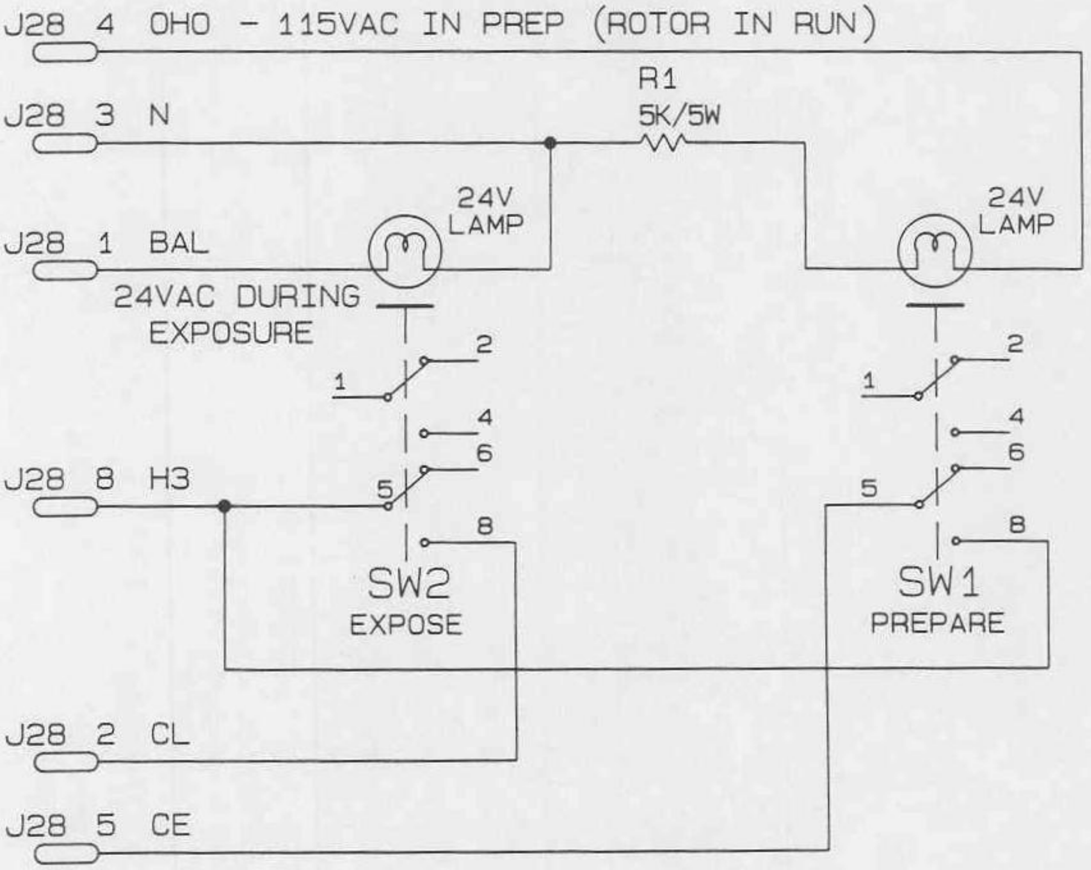

EXPOSE
(MOMENTARY)
BLUE INSERT
PREPARE
(MOMENTARY)
GREEN INSERT
SW2
24V
LAMP
SW1
24V
LAMP
R1
J28
1
2
3
4
5
7
8
10
BAL
CL
N
OHO
CE
H3

MXR-350 PREPARE/EXPOSE PANEL ASM

FIGURE 5-26 LAYOUT FOR 5184.234.08

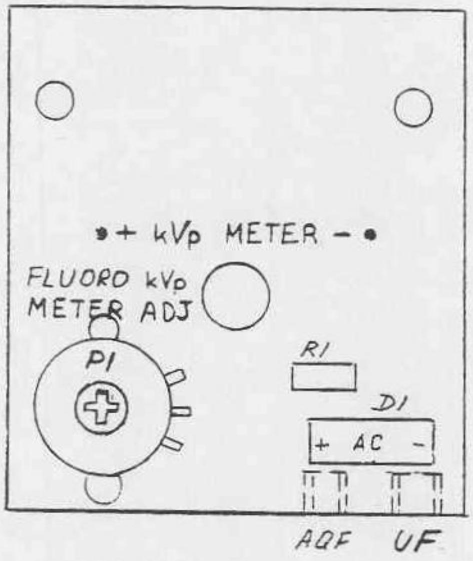
	Part Number	Description	Quantity	Reference Designators
1.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2.	4184.234.08	MXR-350 Prep/Expose Panel PC Blank	1 EA	
3.	717.0113.12	3/4 Square PB Switch Light Shield	2 EA	
4.	717.0113.13	3/4" Square PB Switch Clear Outcap	2 EA	
5.	717.0113.1450	Green Ledex Lens Cap Insert	1 EA	
6.	717.0113.1460	Blue Ledex Lens Cap Insert	1 EA	
7.	717.0113.1491	White Ledex Lens Cap Insert	2 EA	
8.	717.0113.3210	Ledex 24 Volt Slide Base Bulb 20Ma	2 EA	LAMP: SW1,SW2
9.	752.2506.55	5K 5W 5% Fixed WW Low T/C Resistor	1 EA	R1
10.	9181.222.04	2 Pb Ledex Mom Expos/Prepare Switch	1 EA	SW1,SW2

TABLE 5-13 Parts List for 5184.234.08
MXR-350 Prepare/Expose Panel Asm


J28 4 OHO - 115VAC IN PREP (ROTOR IN RUN)
J28 3 N
R1
5K/5W
J28 1 BAL
24VAC DURING
EXPOSURE
24V
LAMP
24V
LAMP
1
2
4
6
5
8
1
2
4
6
5
8
J28 8 H3
SW2
EXPOSE
SW1
PREPARE
J28 2 CL
J28 5 CE

MXR-350 PREP/EXP PANEL ASM

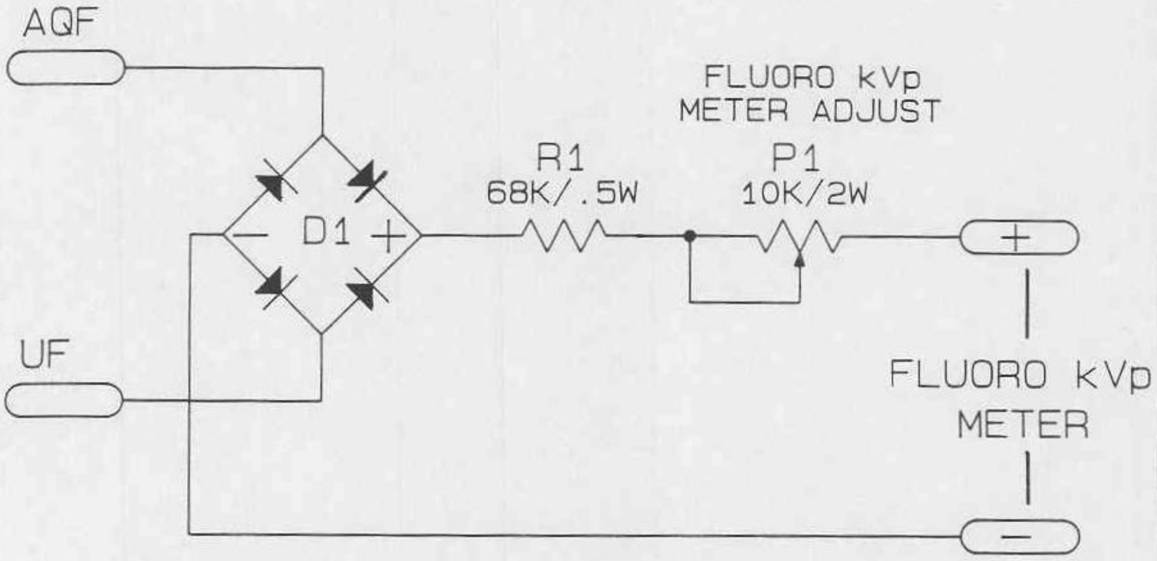
FIGURE 5-27 SCHEMATIC FOR 5184.234.08


+ kVp METER –
FLUORO kVp METER ADJ
P1
R1
D1
+ AC –
AQF
UF

MXR-350 FLUORO kVp METER SHUNT ASM
FIGURE 5-28 LAYOUT FOR 5184.234.09

	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	2 EA	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4182.222.01	Double Tab Terminal	2 EA	
4.	4184.234.09	MXR-350 Fluoro kVp Meter Shunt Blnk	1 EA	
5.	751.1506.6680	68K 1/2 Watt 5% Carbon Resistor	1 EA	R1
6.	755.2206.1001	10K 2 Watt WW Low T/C Potentiometer	1 EA	P1
7.	781.3205.6006	600 PIV 2.0 Amp FW Bridge Rectifier	1 EA	D1

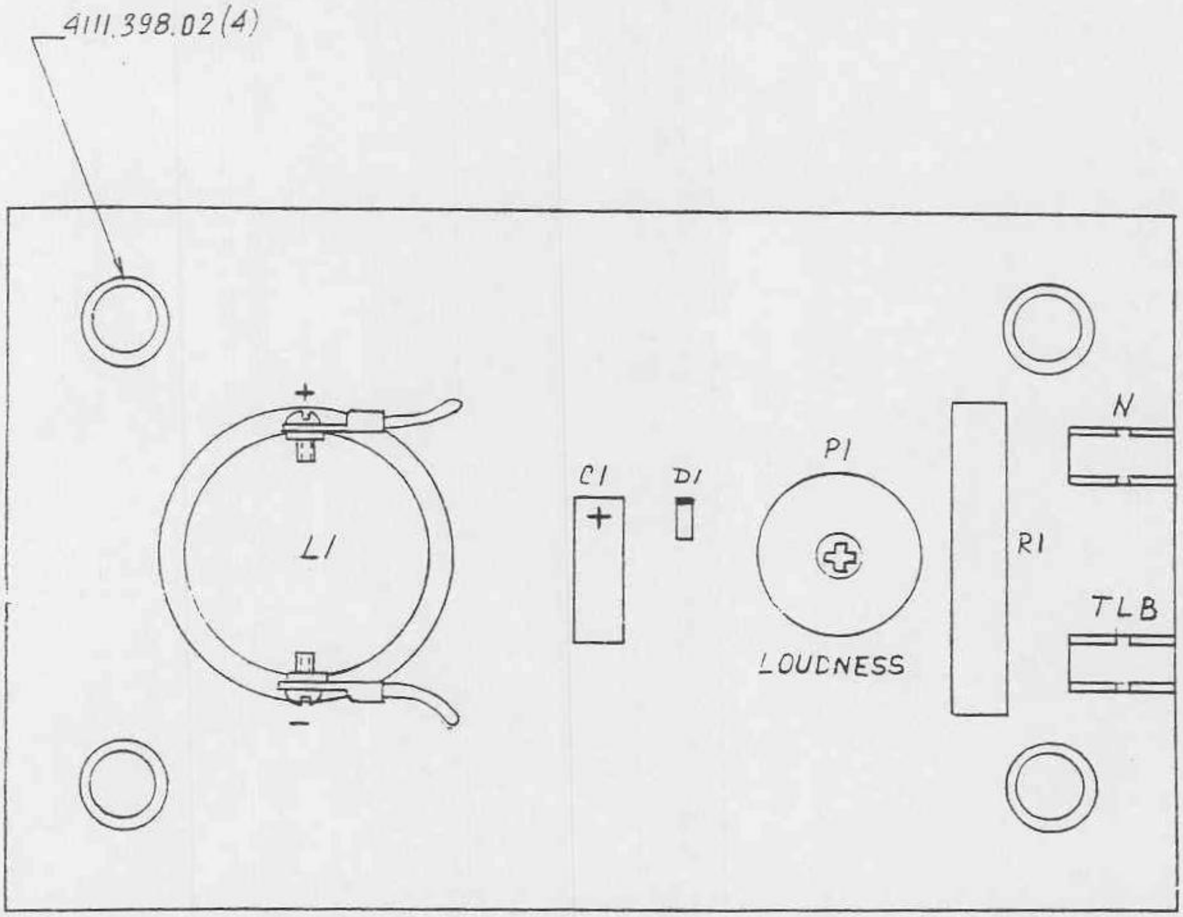
TABLE 5-14 Parts List for 5184.234.09
MXR-350 Fluoro kVp Meter Shunt Asm


AQF
UF
D1
R1
68K/.5W
P1
10K/2W
FLUORO kVp
METER ADJUST
+
−
FLUORO kVp
METER

ADJUST P1 FOR FLUORO kVp METER TO READ
125 kVp WHEN AQF − UF IS 200VAC

MXR-350 FLUORO KVP METER SHUNT ASM

FIGURE 5-29 SCHEMATIC FOR 5184.234.09

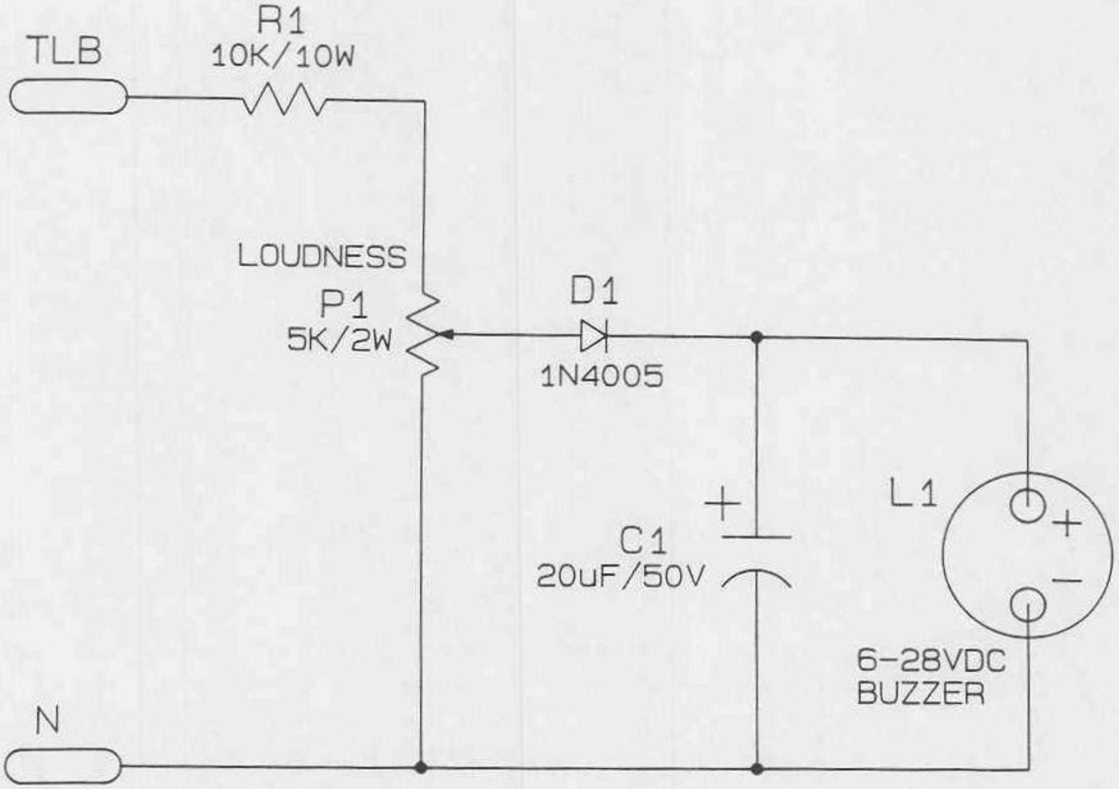

4111.398.02(4)
+
L1
−
C1
+
D1
P1
LOUDNESS
R1
N
TLB

MXR-350 FLUORO EXPOSURE INDCTR ASM

FIGURE 5-30 LAYOUT FOR 5184.234.10

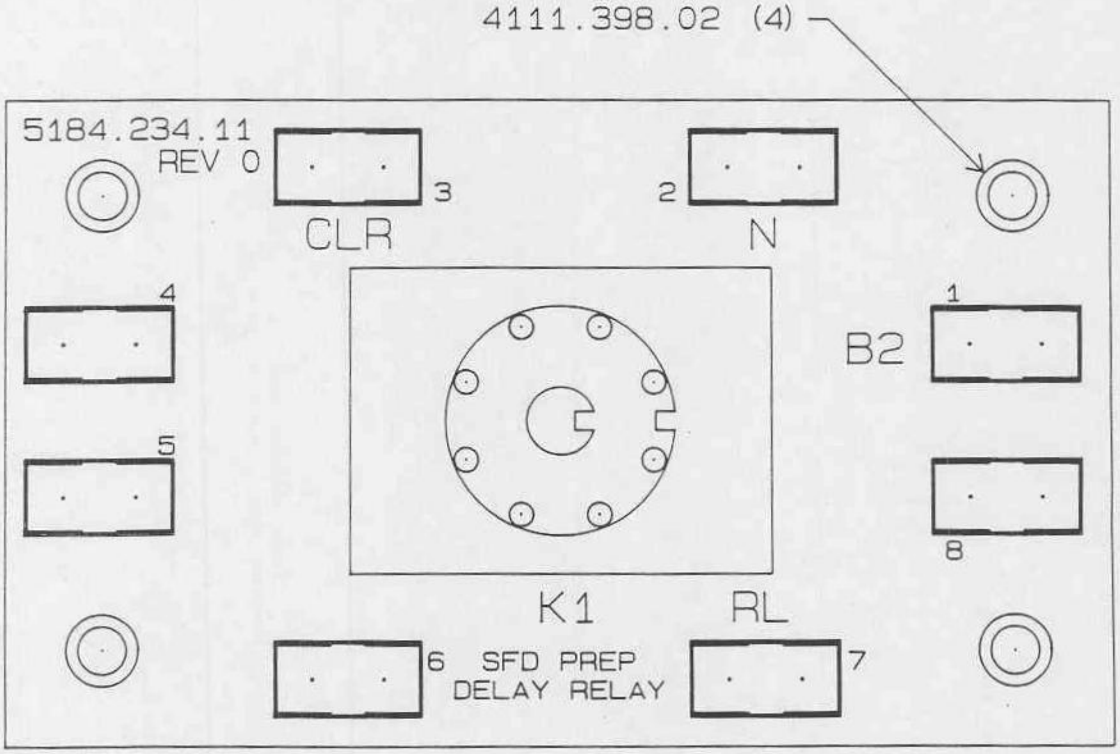
	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	4 EA	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
4.	4180.232.01	Sonalert Short Pulse Signal Module	1 EA	L1
5.	4182.122.06	22-16 X 1/4 Ring Terminal	2 EA	
6.	4182.132.12	4-Way Tab Terminal	2 EA	
7.	4184.234.10	MXR-350 Fluoro Expsr Indctr PC Blnk	1 EA	
8.	733.2207.0111	22 Ga 1 Con 300v Brown Hookup Wire	.25 FT	
9.	733.2207.0121	22 Ga 1 Con 300v Red Hookup Wire	.25 FT	
10.	752.3106.61	10K 10Watt 5% FxdWW Low T/C Resistr	1 EA	R1
11.	755.2205.5001	5K 2 Watt WW Low T/C Potentiometer	1 EA	P1
12.	771.1620.0350	20 Mfd 50 Vdc Electrolytc Capacitor	1 EA	C1
13.	782.1040.05	1N4005 1A 600V Silicon Rectifier	1 EA	D1

TABLE 5-15 Parts List for 5184.234.10
MXR-350 Fluoro Exposure Indictr Asm


R1
10K/10W
TLB
LOUDNESS
P1
5K/2W
D1
1N4005
C1
20uF/50V
+
L1
+
−
6−28VDC
BUZZER
N

MXR-350 FLUORO EXPOSURE INDICATOR ASM

FIGURE 5-31 SCHEMATIC FOR 5184.234.10

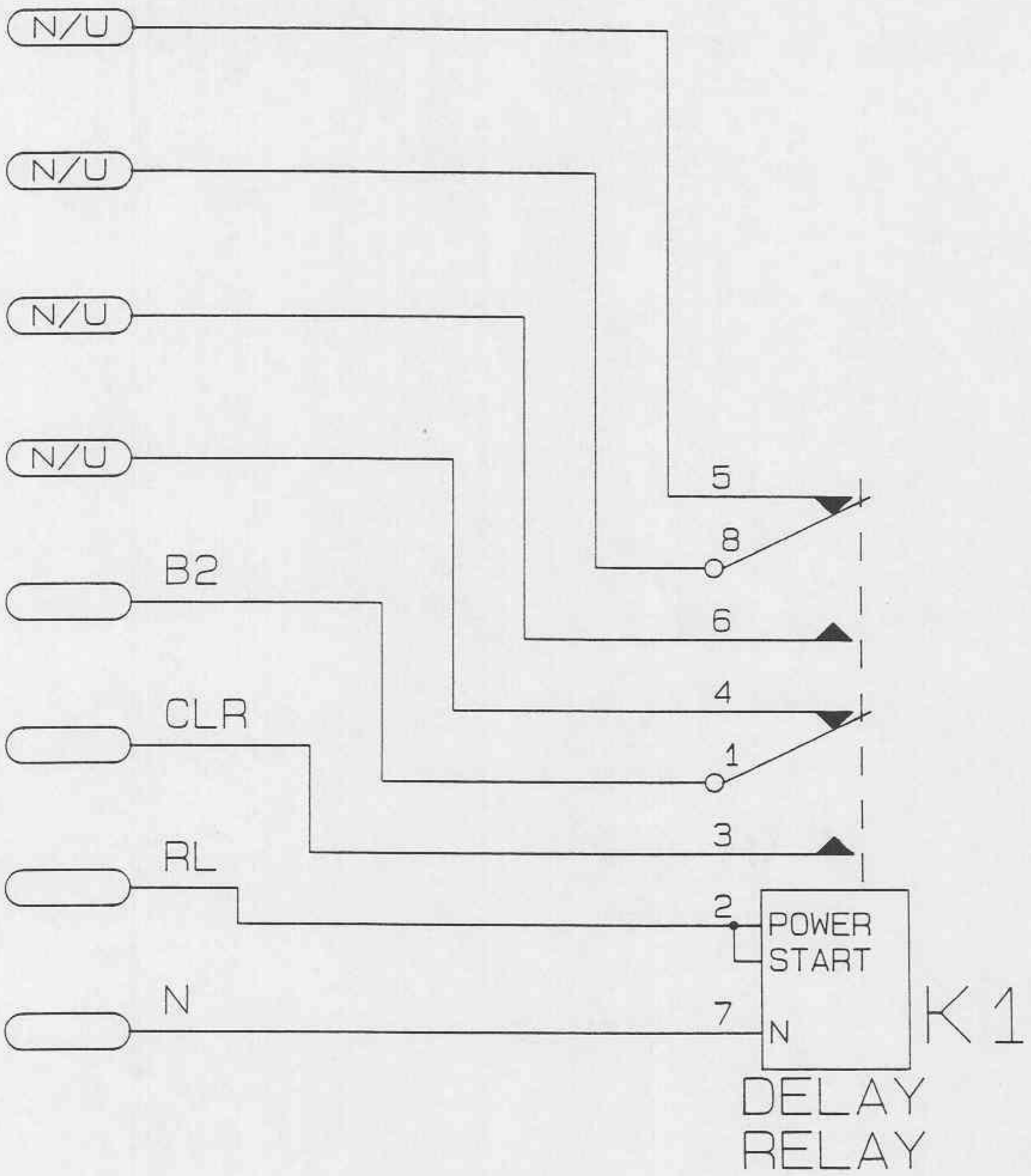

4111.398.02 (4)
5184.234.11
REV 0
3
CLR
2
N
4
1
B2
5
8
K1
RL
6
SFD PREP
DELAY RELAY
7

MXR-350 SFD PREP DELAY RELAY ASM

FIGURE 5-32 LAYOUT FOR 5184.234.11

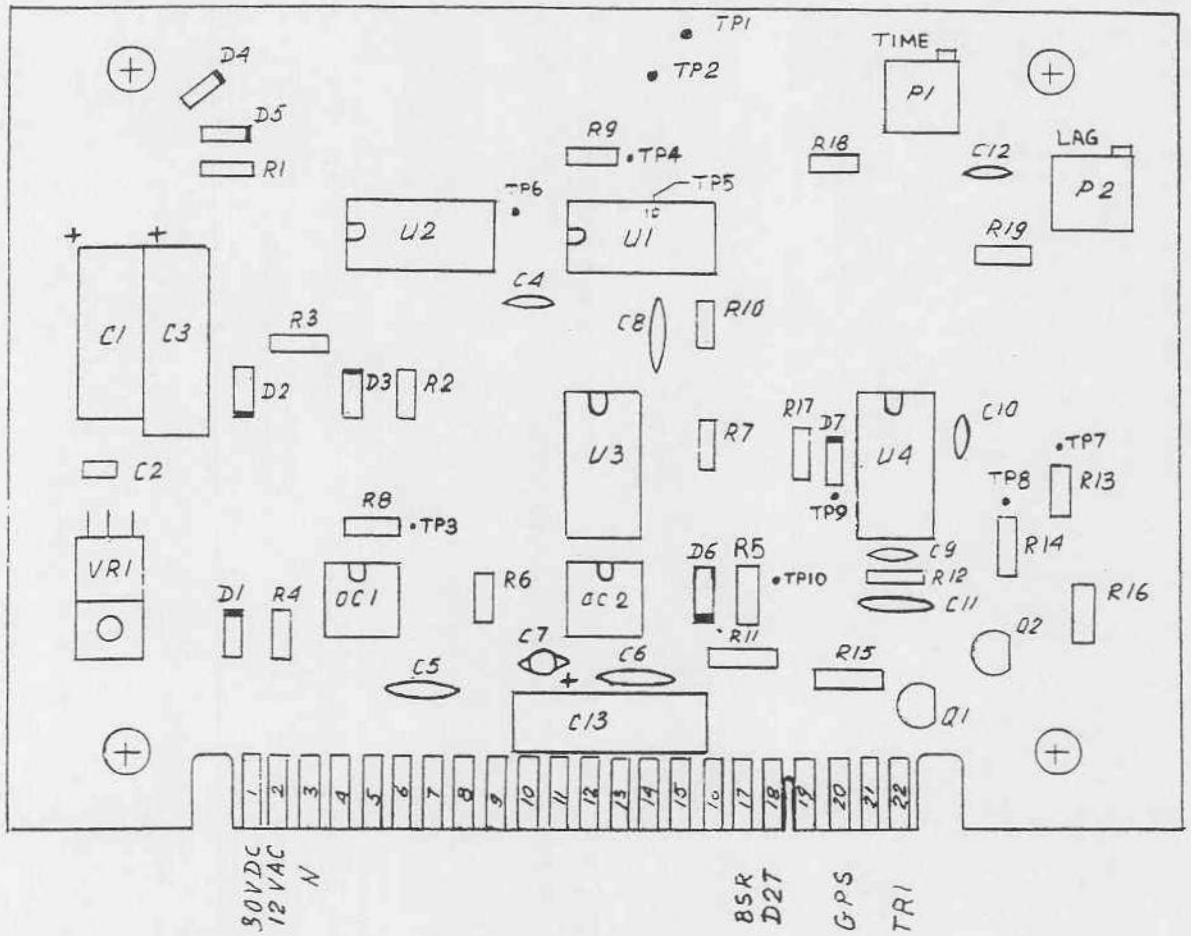
	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	16 EA	
2.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
3.	4180.230.04	DPDT Delay On Operate Relay	1 EA	K1
4.	4182.132.12	4-Way Tab Terminal	8 EA	
5.	4182.222.04	8 Pin Octal Socket	1 EA	
6.	4184.234.11	MXR-350 SFD Prep Delay Relay Blank	1 EA	

TABLE 5-16 Parts List for 5184.234.11
MXR-350 SFD Prep Delay Relay Asm


N/U
N/U
N/U
N/U
B2
CLR
RL
N
5
8
6
4
1
3
2
7
POWER
START
N
K1
DELAY
RELAY

MXR-350 SFD PREP DELAY RELAY ASM

FIGURE 5-33 SCHEMATIC FOR 5184.234.11


TP1
TIME
D4
TP2
P1
D5
R9
TP4
R18
LAG
R1
C12
TP6
TP5
P2
U2
U1
R19
C4
C1
C3
CB
R10
R3
D3
R2
D2
R17
D7
C10
R7
TP7
U3
U4
C2
R13
TP9
TP8
R8
TP3
R14
D6
R5
C9
VR1
R6
TP10
R12
R16
D1
R4
OC1
OC2
C11
C7
R11
Q2
R15
C5
C6
C13
Q1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
30VDC
12VAC
N
BSR
D2T
GPS
TRI

MXR-350 SINGLE PHASE IMPULSE TIMER ASM

FIGURE 5-34 LAYOUT FOR 5184.234.12

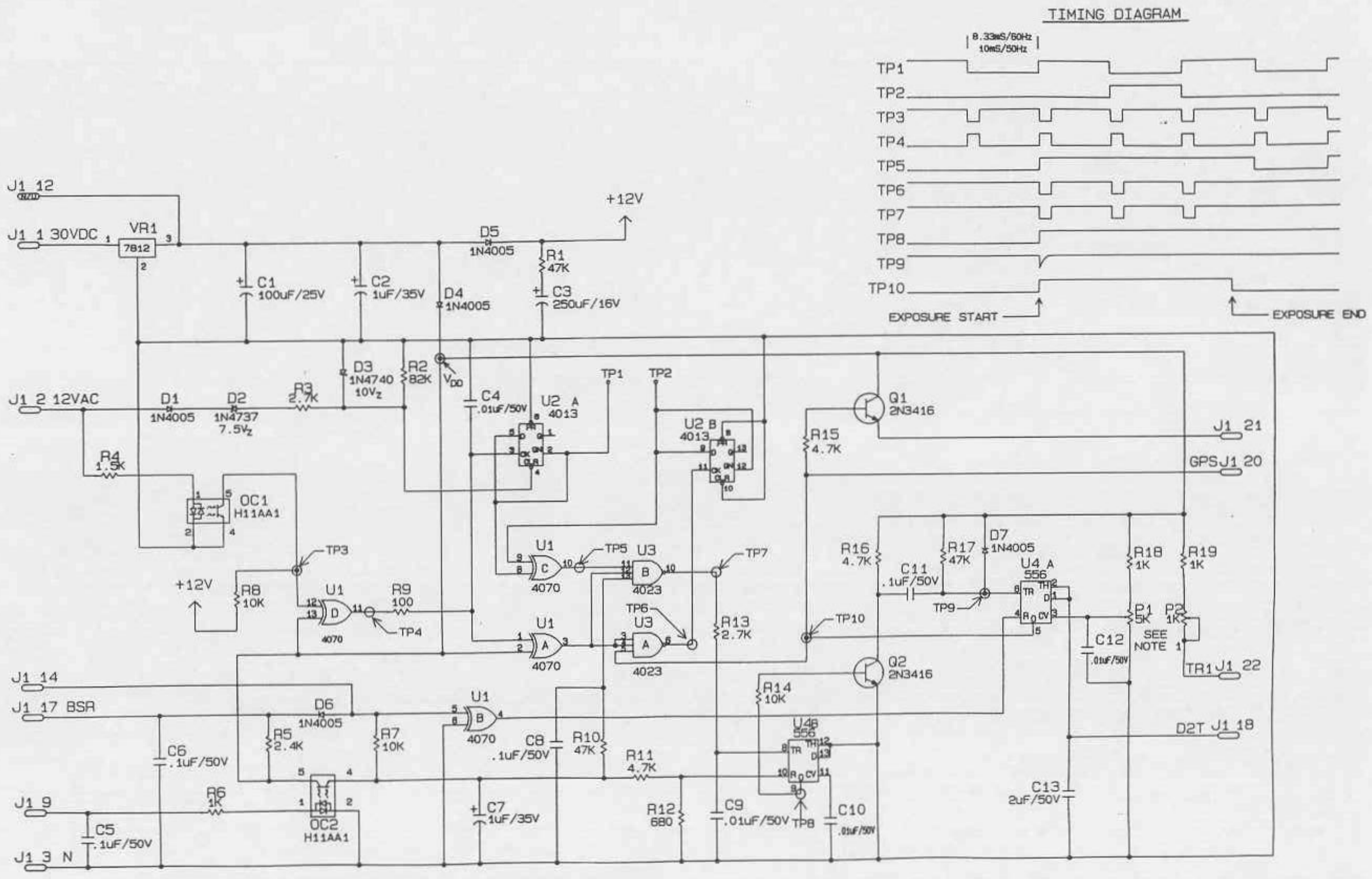
	Part Number	Description	Quantity	Designators
1.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2.	4184.234.12	MXR-350 1-Phase Impulse Tmr PC Blnk	1 EA	
3.	751.1256.41	100 Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R9
4.	751.1256.4680	680 Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R12
5.	751.1256.51	1.0K 1/4 Watt 5% Carbon Resistor	3 EA	R6,18,19
6.	751.1256.5150	1.5K 1/4 Watt 5% Carbon Resistor	1 EA	R4
7.	751.1256.5240	2.4K 1/4 Watt 5% Carbon Resistor	1 EA	R5
8.	751.1256.5270	2.7K 1/4 Watt 5% Carbon Resistor	2 EA	R3,13
9.	751.1256.5470	4.7K 1/4 Watt 5% Carbon Resistor	3 EA	R11,15,16
10.	751.1256.61	10K Ohm 1/4 Watt 5% Carbon Resistor	3 EA	R7,8,14
11.	751.1256.6470	47K Ohm 1/4 Watt 5% Carbon Resistor	3 EA	R1,10,17
12.	751.1256.6820	82K Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R2
13.	754.1505.1011	1/2W 1K 20T Vert Adj 3/8 Sq Potmtr	1 EA	P2
14.	754.1505.5011	5K .5W 20 Turn 3/8 Sq Vert Adj Pot	1 EA	P1
15.	764.1020.10	Cambion Type K 2085-02 PC Terminal	4 EA	TP1,2,6,10
16.	771.1710.0325	100 Mfd 25 V Electrlytc Capacitor	1 EA	C1
17.	771.1725.1315	250 Mfd 15 Volt Elctyc Capacitor	1 EA	C3
18.	773.1520.4350	2 Mfd 50 Volt #1 Mylar Capacitor	1 EA	C13
19.	776.1310.0350	.01 MFD 50V Ceramic Disc Capacitor	4 EA	C4,9,10,12
20.	776.1410.1350	.1 Mfd 50 Volt Disc Capacitor	4 EA	C5,6,8,11
21.	776.3301.0410	.01 Mfd 100 VDC Cpctr W/Rad Leads	1 EA	C2
22.	777.1510.3335	1.0Mfd 35 V Rad Ld Tantlm Capacitor	1 EA	C7
23.	782.1040.05	1N4005 1A 600V Silicon Rectifier	5 EA	D1,4,5,6,7
24.	782.1047.37	1N4737 7.5 Volt 1 Watt 10% Zener	1 EA	D2
25.	782.2034.16	2N3416 Transistor NPN	2 EA	Q1,2
26.	783.4103.1040	10 Volt 1 Watt Zener Diode	1 EA	D3

. . . continued on next page

TABLE 5-17 Parts List for 5184.234.12
MXR-350 Single Phase Impls Tmr Asm

	Part Number	Description	Quantity	Reference Designators
27.	786.1222.5562	556 Dual IC Timer - Ceramic Hi Temp	1 EA	U4
28.	786.2108.8122	7812 1A 12V Pos Voltage Regulator	1 EA	VR1
29.	786.3223.13	4013 CMOS Dual FF-Ceramic, Hi Temp	1 EA	U2
30.	786.3223.23	4023 CMOS Triple 3-In NAND Hi Temp	1 EA	U3
31.	786.3223.70	4070 CMOS XOR GATE Ceramic Hi Temp	1 EA	U1
32.	786.9109.8011	H11AA1 AC Darlington Opto Coupler	2 EA	OC1,2

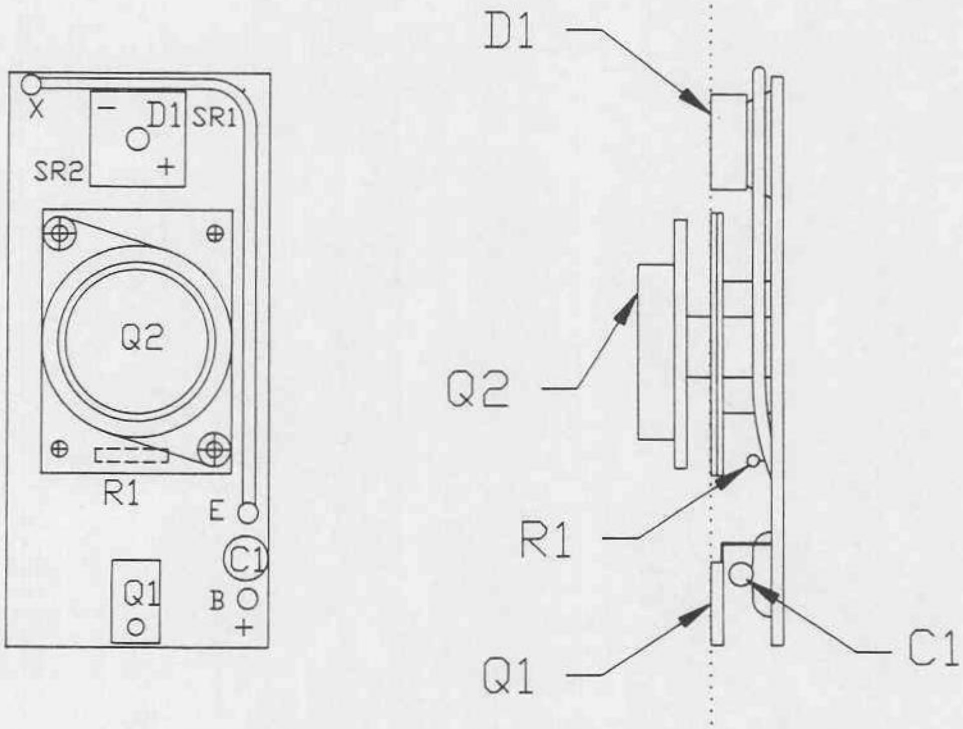
TABLE 5-17 Parts List for 5184.234.12
MXR-350 Single Phase Impls Tmr Asm



TIMING DIAGRAM
8.33mS/60Hz
10mS/50Hz
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP10
EXPOSURE START
EXPOSURE END
J1 12
J1 1 30VDC
VR1
7812
+12V
D5
1N4005
R1
47K
C1
100uF/25V
C2
1uF/35V
D4
1N4005
C3
250uF/16V
J1 2 12VAC
D1
1N4005
D2
1N4737
7.5VZ
R3
2.7K
D3
1N4740
10VZ
R2
82K
VDD
C4
.01uF/50V
U2 A
4013
TP1
TP2
U2 B
4013
Q1
2N3416
J1 21
R15
4.7K
GPS J1 20
R4
1.5K
OC1
H11AA1
TP3
R8
10K
U1
R9
100
D
4070
TP4
C
TP5
U3
B
4023
TP7
TP6
A
R13
2.7K
TP10
R16
4.7K
R17
47K
D7
1N4005
U4 A
556
C11
.1uF/50V
TP9
R18
1K
R19
1K
P1
5K
P2
1K
SEE NOTE 1
C12
.01uF/50V
TR1 J1 22
Q2
2N3416
J1 14
J1 17 BSR
D6
1N4005
R5
2.4K
R7
10K
C6
.1uF/50V
C8
.1uF/50V
R10
47K
R11
4.7K
R14
10K
U4B
556
D2T J1 18
C13
2uF/50V
J1 9
R6
1K
OC2
H11AA1
C7
1uF/35V
R12
680
C9
.01uF/50V
TP8
C10
.01uF/50V
C5
.1uF/50V
J1 3 N

NOTES:
1. P1 - OVERALL TIME ADJUST
   P2 - SHORT TIME ADJUST
2. +12V TO PIN 14 OF U2
3. V_{DD} TO PIN 14 OF U1, U3, U4
4. N TO PIN 7 OF U1, U2, U3, U4

MXR-350 SINGLE PHASE IMPULSE TIMER ASM
FIGURE 5-35 SCHEMATIC FOR 5184.234.12


X
−
D1
SR1
SR2
+
Q2
R1
E
C1
Q1
B
+
D1
Q2
R1
C1
Q1

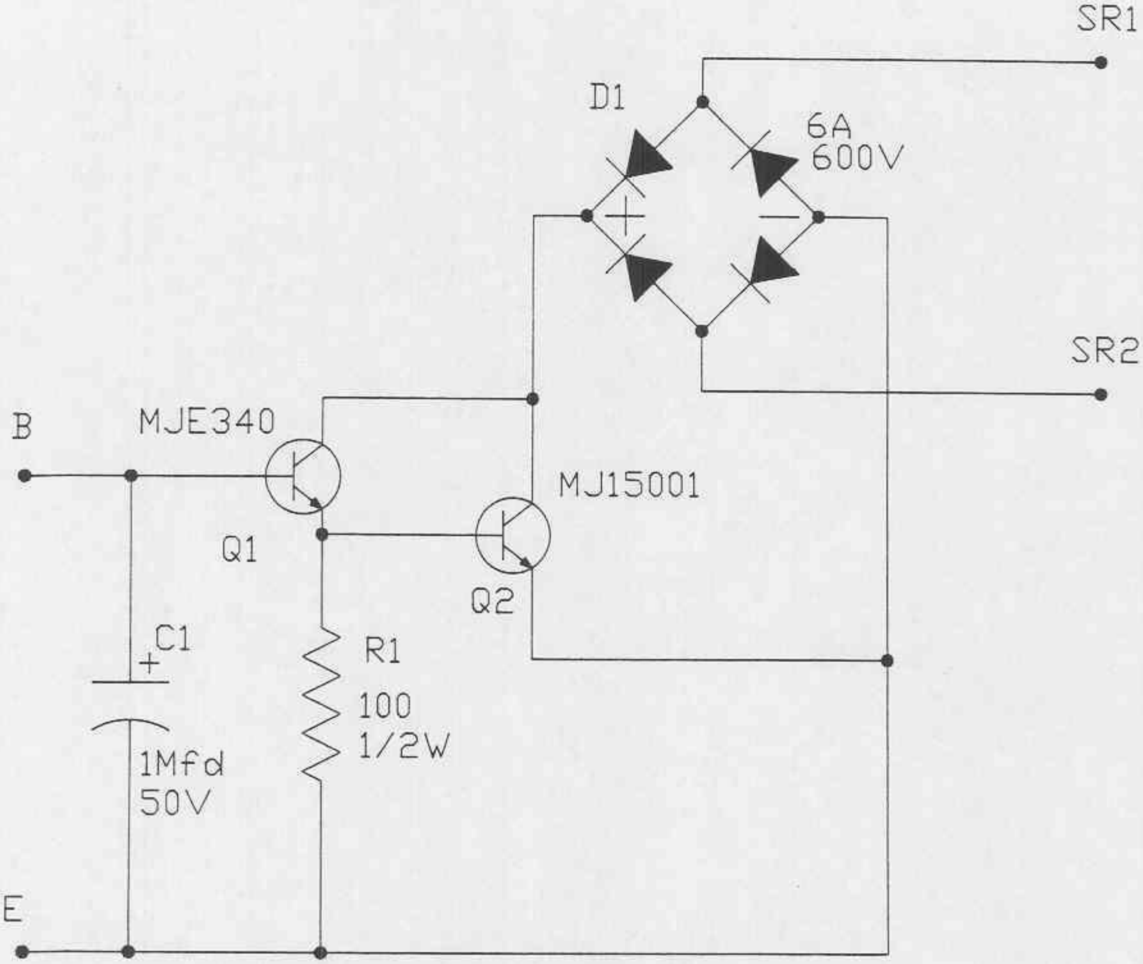
ASSEMBLY CONFORMAL COATED WITH GE SR900 SILICONE RESIN SOLUTION. - DO NOT COAT Q2 OR SURFACES OF Q1 AND D1. - ALSO KEEP CONFORMAL COATING OFF OF SOCKET CONTACTS AND PADS FOR EXTERNAL CONNECTIONS SR1 AND SR2.

MXR-350 FILAMENT DRIVE TRANSISTOR ASM

FIGURE 5-36 LAYOUT FOR 5184.234.19

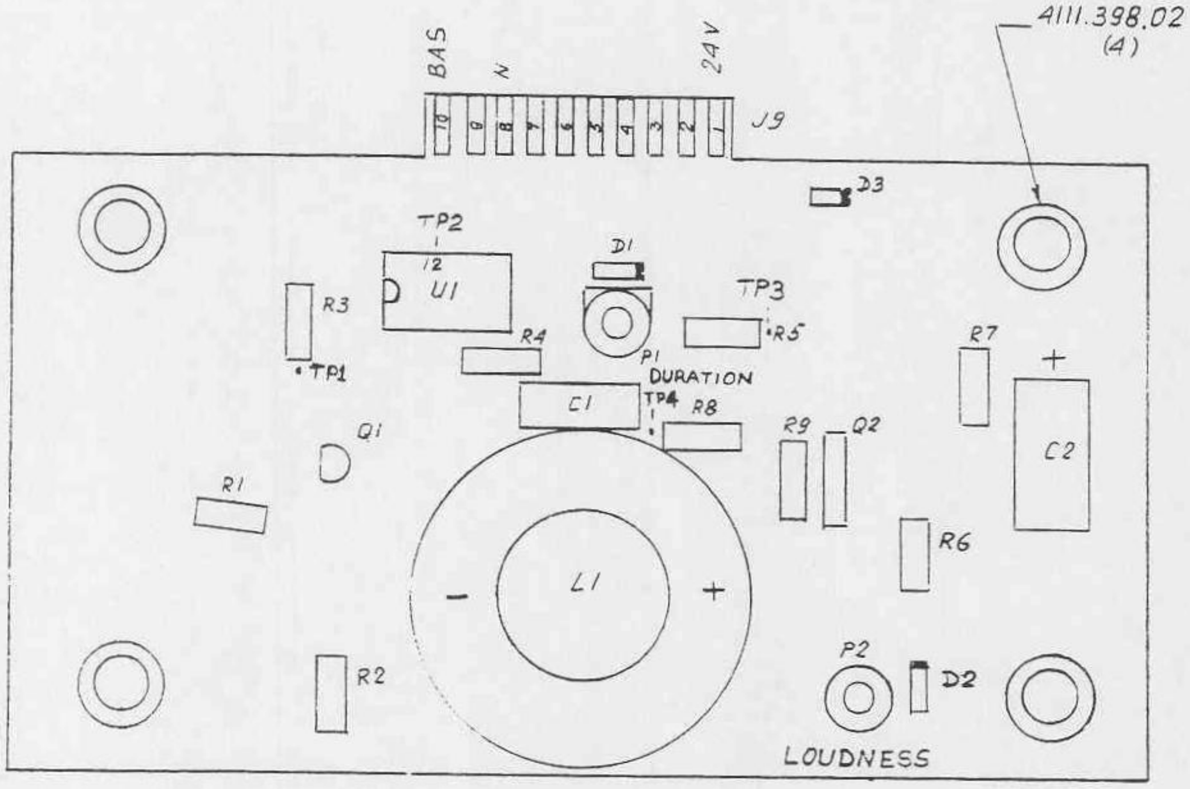
	Part Number	Description	Quantity	Reference Designators
1.	135.3416.01	#16 Teflon Insulating Tubing	.20 FT	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4182.410.11	Transistor Socket	1 EA	
4.	4184.234.19	MXR-350 Filmnt Drive Trnstr PC Blnk	1 EA	
5.	4189.217.03	MJE 340 Transistor	1 EA	Q1
6.	738.0320.	20 Awg Solid Tinned Copper Wire	.20 FT	
7.	751.1506.41	100R 1/2 Watt 5% Carbon Resistor	1 EA	R1
8.	777.1510.3335	1.0Mfd 35 V Rad Ld Tantlm Capacitor	1 EA	C1
9.	781.3605.6008	6A 600 PIV Silicon Bridge Rectifier	1 EA	D1
10.	785.0223.1401	MJ15001 NPN, 20A, 140V, 200W, TO-3	1 EA	Q2

TABLE 5-18 Parts List for 5184.234.19
MXR-350 Filament Drive Transtor Asm


SR1
D1
6A
600V
+
−
SR2
B
MJE340
MJ15001
Q1
Q2
C1
+
R1
100
1/2W
1Mfd
50V
E

MXR-350 FILAMENT DRIVE TRANSISTOR ASM

FIGURE 5-37 SCHEMATIC FOR 5184.234.19

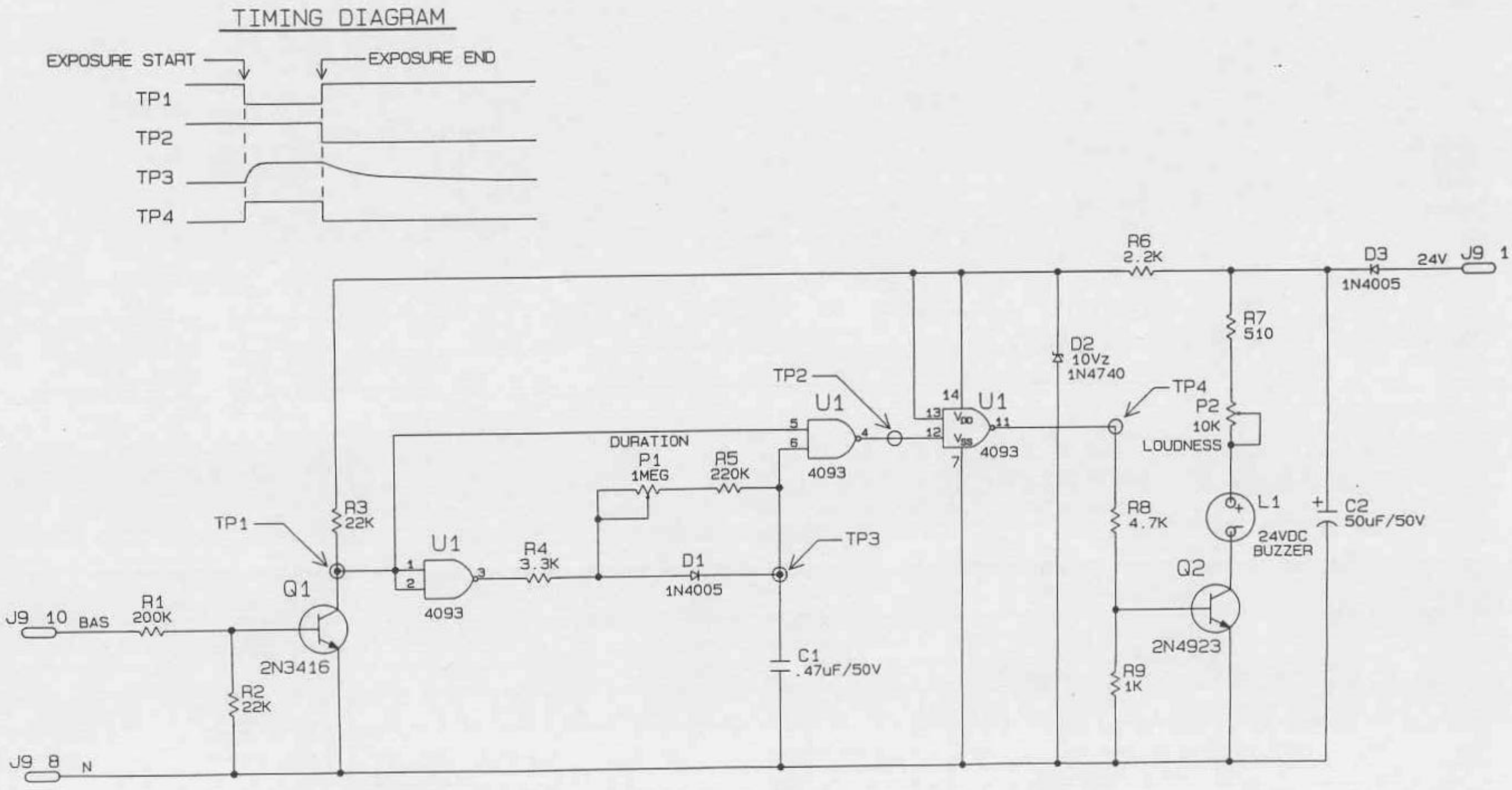

4111.398.02
(4)
BAS
N
24V
10
9
8
7
6
5
4
3
2
1
J9
D3
TP2
12
U1
D1
TP3
R3
R4
R5
TP1
P1
DURATION
TP4
R8
C1
Q1
R9
Q2
R7
+
C2
R1
R6
L1
-
+
P2
D2
R2
LOUDNESS

MXR-350 24VDC EXPOSURE END BUZZ ASM

FIGURE 5-38 LAYOUT FOR 5184.234.2901

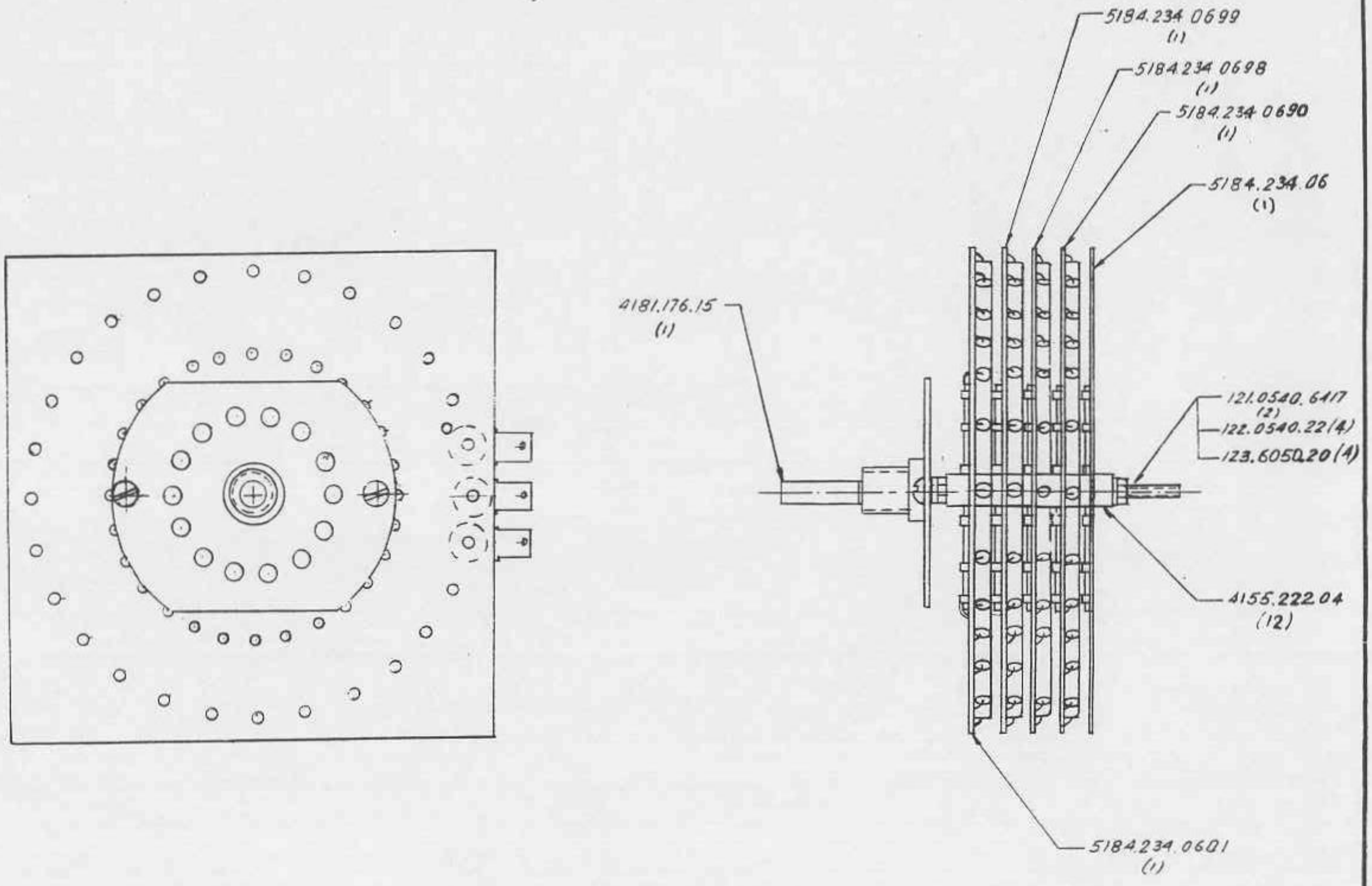
	Part Number	Description	Quantity	Reference Designators
1.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
3.	4180.217.14	4-28 Vdc PC Mntd Sonalert Signal	1 EA	L1
4.	4184.234.2901	MXR-350 24VDC Exp End Buzz PC Blnk	1 EA	
5.	751.1506.4510	510R 1/2 Watt 5% Carbon Resistor	1 EA	R7
6.	751.1506.51	1K 1/2 Watt 5% Carbon Resistor	1 EA	R9
7.	751.1506.5220	2.2K 1/2 Watt 5% Carbon Resistor	1 EA	R6
8.	751.1506.5330	3.3K 1/2 Watt 5% Carbon Resistor	1 EA	R4
9.	751.1506.5470	4.7K 1/2 Watt 5% Carbon Resistor	1 EA	R8
10.	751.1506.6220	22K 1/2 Watt 5% Carbon Resistor	2 EA	R2,3
11.	751.1506.72	200K 1/2 Watt 5% Carbon Resistor	1 EA	R1
12.	751.1506.7220	220K 1/2 Watt 5% Carbon Resistor	1 EA	R5
13.	754.1506.1010	10K Cermet 4-Turn Potentiometer	1 EA	P2
14.	754.1508.1012	1M Cermet 4-Turn Pot, Top Adj	1 EA	P1
15.	771.1650.1350	50 Mfd 50 Volt DC Elctyc Capacitor	1 EA	C2
16.	773.1447.3350	.47 MFD 50 WVDC Mylar Capacitor	1 EA	C1
17.	782.1040.05	1N4005 1A 600V Silicon Rectifier	2 EA	D1,3
18.	782.1047.40	1N4740 10 Volt 1 Watt Zener Diode	1 EA	D2
19.	782.2034.16	2N3416 Transistor NPN	1 EA	Q1
20.	782.2049.23	2N4923 Transistor	1 EA	Q2
21.	786.3223.93	4093 Quad 2-In NAND Schmt Tr Hi Tmp	1 EA	U1

TABLE 5-19 Parts List for 5184.234.2901
MXR-350 24VDC Exposure End Buzz Asm


TIMING DIAGRAM
EXPOSURE START
EXPOSURE END
TP1
TP2
TP3
TP4
J9 10 BAS
R1 200K
R2 22K
Q1
2N3416
TP1
R3 22K
U1
4093
R4 3.3K
DURATION
P1 1MEG
R5 220K
D1 1N4005
TP3
C1 .47uF/50V
TP2
U1
4093
U1
4093
14
13
12
7
11
VDD
VSS
D2 10Vz 1N4740
R6 2.2K
TP4
R8 4.7K
R9 1K
Q2
2N4923
P2 10K LOUDNESS
R7 510
L1 24VDC BUZZER
C2 50uF/50V
D3 1N4005
24V
J9 1
J9 8 N

ALL RESISTORS 1/2W UNLESS OTHERWISE SPECIFIED

MXR-350 24 VDC EXPOSURE END BUZZ ASM
FIGURE 5-39 SCHEMATIC FOR 5184.234.2901


5184.234 0699
(1)
5184.234 0698
(1)
5184.234 0690
(1)
5184.234.06
(1)
4181.176.15
(1)
121.0540.6417
(2)
122.0540.22(4)
123.6050.20(4)
4155.222.04
(12)
5184.234.0601
(1)

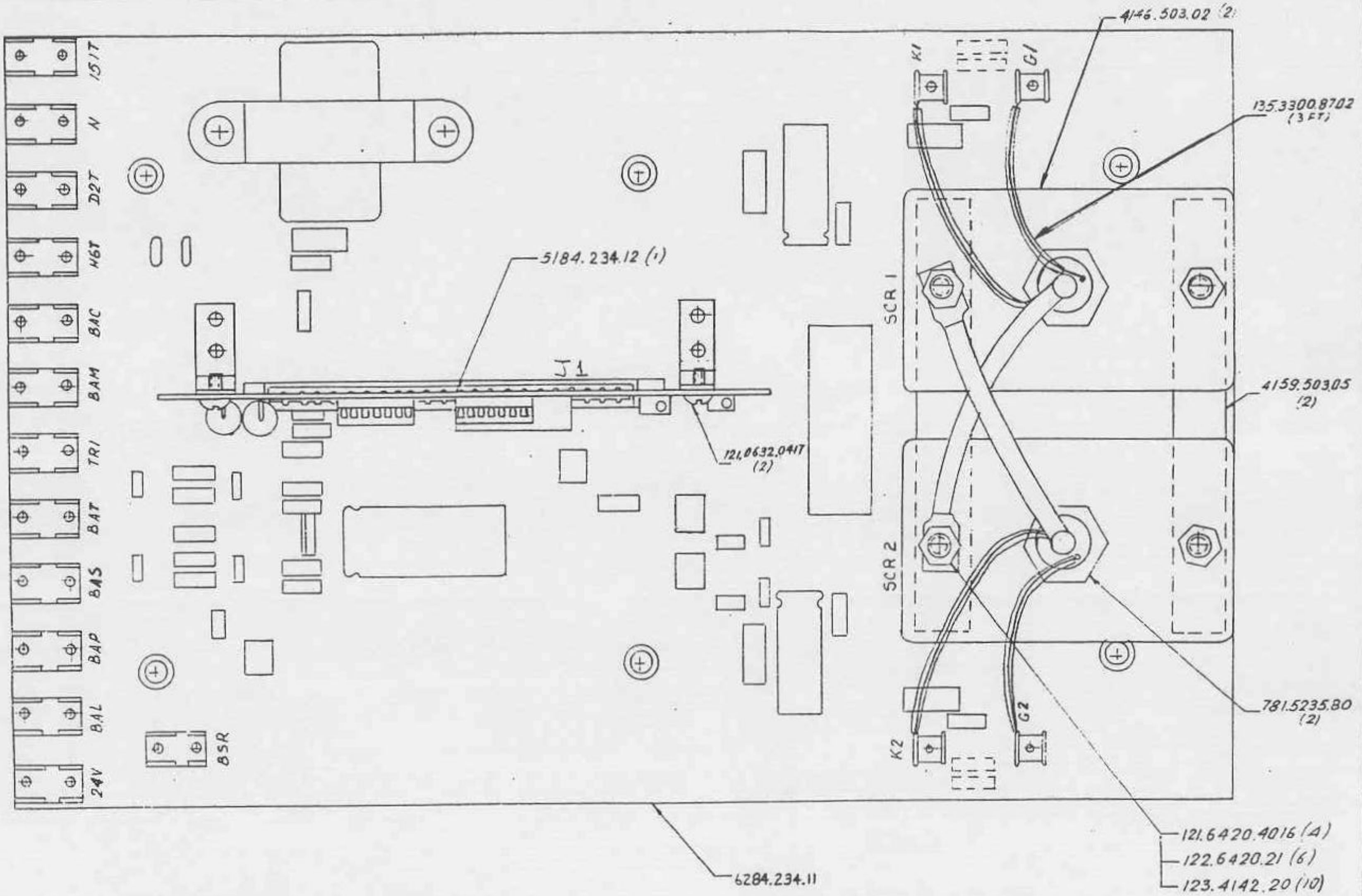
MXR-350 TIMER SWITCH ASM

FIGURE 5-40 LAYOUT FOR 5281.234.02

DIETZGEN NO. 199M AGEPROOF NO. 215.12

	Part Number	Description	Quantity		Reference Designators
1.	121.0540.6417	5-40 X 4 Round Steel Phillips Screw	2	EA	
2.	122.0540.22	5-40 Double Chamfered Hex Steel Nut	4	EA	
3.	123.6050.20	#5 Internal Tooth Steel Lockwasher	4	EA	
4.	4155.222.15	5/16 Inch Spacer	12	EA	
5.	4181.176.15	4 Inch Switch Shaft Assembly	1	EA	
6.	5184.234.06	MXR-350 Timer Safety Switch Asm	1	EA	
7.	5184.234.0601	Mil.60Hz Impulse Timer Resistor Asm	1	EA	
8.	5184.234.0690	MXR-350 Universal TOLA Resistor Asm	1	EA	
9.	5184.234.0698	MXR-350 Backup Timer Resistor Asm	1	EA	
10.	5184.234.0699	Mil.50Hz Impulse Timer Resistor Asm	1	EA	

TABLE 5-20 Parts List for 5281.234.02
MXR-350 Timer Switch Assembly



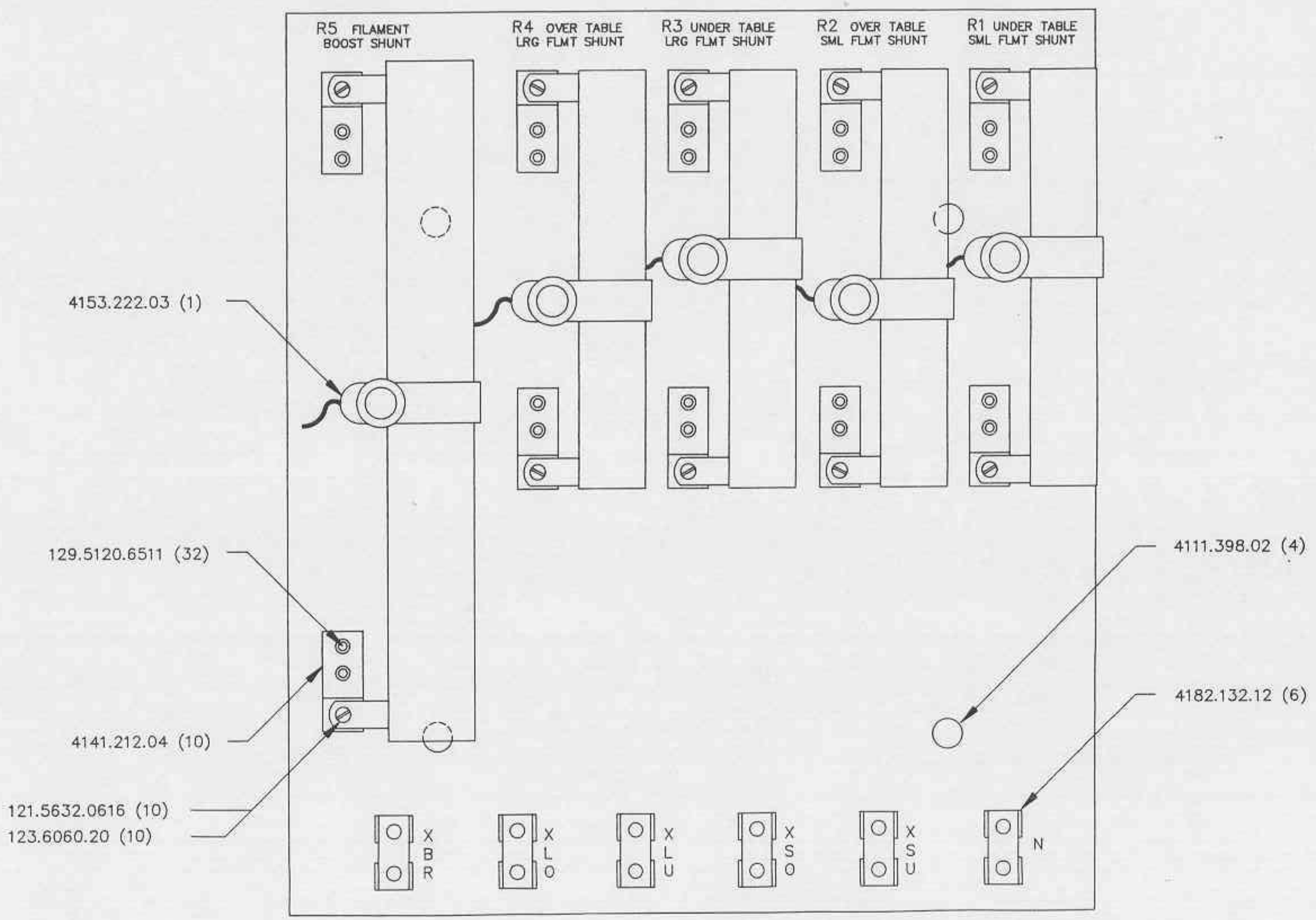
4146.503.02 (2)
135.3300.8702 (3 FT)
4159.503.05 (2)
781.5235.80 (2)
121.6420.4016 (4)
122.6420.21 (6)
123.4142.20 (10)
6284.234.11
5184.234.12 (1)
121.0632.0417 (2)
J1
151T
N
D2T
H6T
BAC
BAM
TRI
BAT
BAS
BAP
BAL
24V
BSR
SCR 1
SCR 2
K1
G1
K2
G2

MXR-350 235A 800V IMPULSE TIMER/CONTACTOR

FIGURE 5-41 LAYOUT FOR 5284.234.1102

	Part Number	Description	Quantity	Reference Designators
1.	121.0632.0417	6-32 X 1/4 Round Steel Philps Screw	2 EA	
2.	121.6420.4016	1/4-20 X 2-1/2 Round Hd Brass Screw	4 EA	
3.	122.6420.21	1/4-20 Brass Double Chamfrd Hex Nut	6 EA	
4.	123.6140.20	1/4 Internal Tooth Steel Lockwasher	6 EA	
5.	135.3212.02	#12 Red Temflex Tubing	.75 FT	
6.	135.3212.09	#12 White Temflex Tubing	.75 FT	
7.	4146.503.02	235A SCR Heat Sink Plate	2 EA	
8.	4159.503.05	1 Inch It Heat Sink Standoff	2 EA	
9.	5184.234.12	MXR-350 Single Phase Impls Tmr Asm	1 EA	
10.	6284.234.11	MXR-350 SCR Contactor-Timer Intrfc	1 EA	
11.	762.8521.0001	.250 #18 Female Cont Strip Tab Term	4 EA	
12.	781.5235.80	235 A RMS 800 PIV SCR	2 EA	SCR1,SCR2

TABLE 5-21 Parts List for 5284.234.1102
MXR-350 235A 800V Impls Tmr-Contctr


R5 FILAMENT BOOST SHUNT
R4 OVER TABLE LRG FLMT SHUNT
R3 UNDER TABLE LRG FLMT SHUNT
R2 OVER TABLE SML FLMT SHUNT
R1 UNDER TABLE SML FLMT SHUNT
4153.222.03 (1)
129.5120.6511 (32)
4141.212.04 (10)
121.5632.0616 (10)
123.6060.20 (10)
4111.398.02 (4)
4182.132.12 (6)
XBR
XLO
XLU
XSO
XSU
N

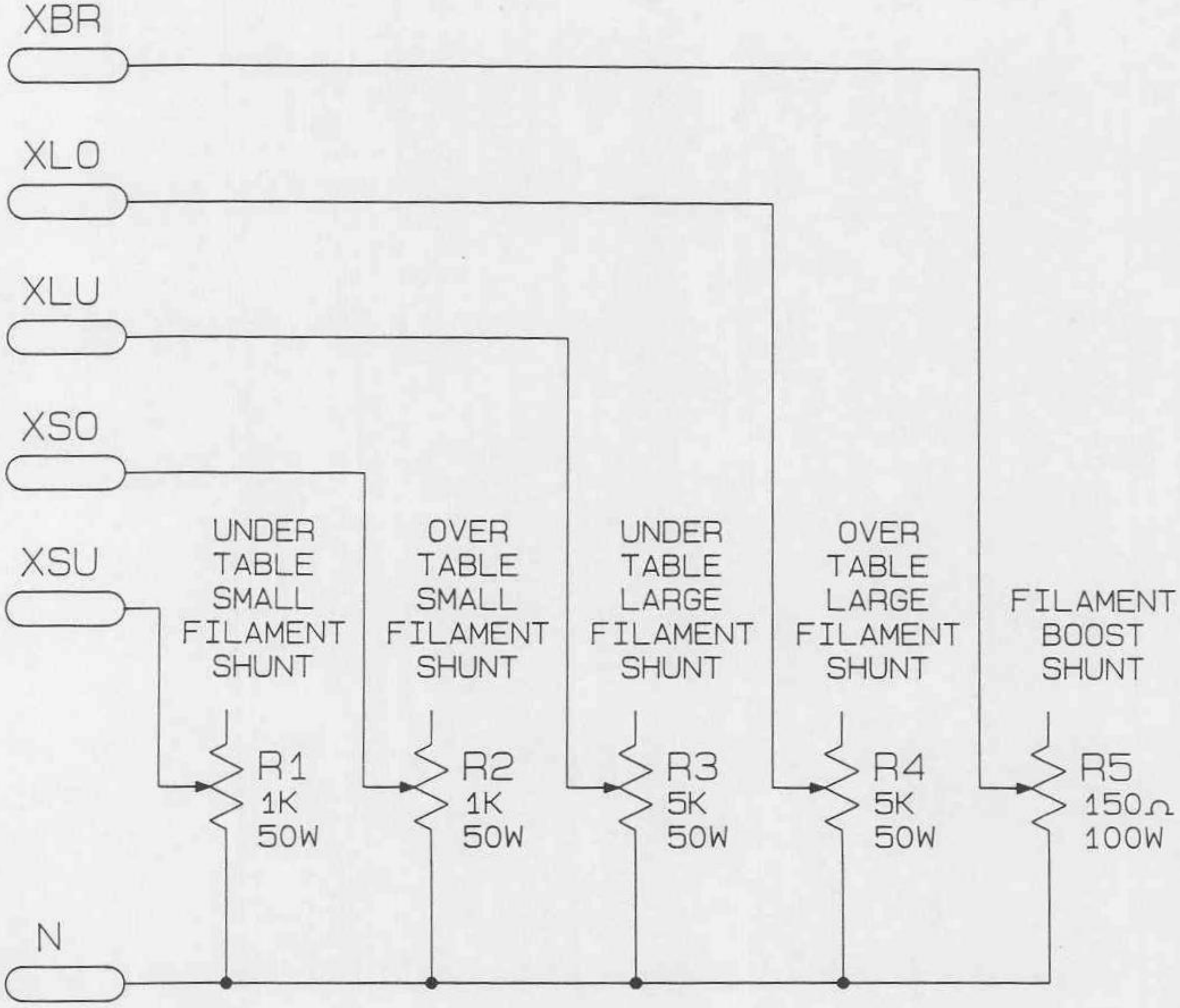
ASSEMBLY CONFORMAL COATED WITH GE SR900
SILICONE RESIN SOLUTION.

MXR-350 3P FILAMENT RESISTOR PANEL ASM

FIGURE 5-42 LAYOUT FOR 5284.234.15

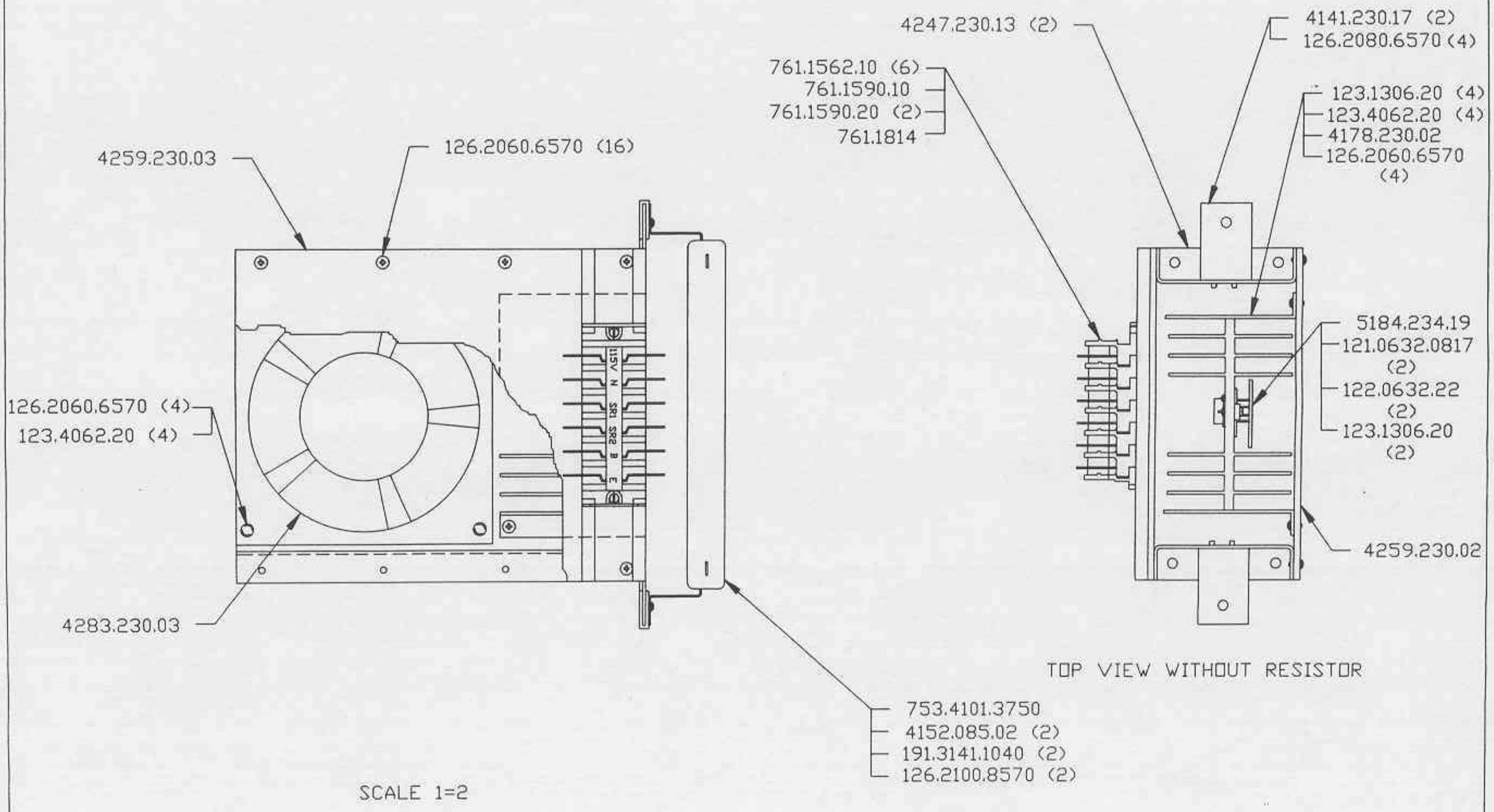
	Part Number	Description	Quantity	Reference Designators
1.	121.5632.0616	6-32 X 3/8 Brass Phil Rd Head Screw	10 EA	
2.	123.6060.20	#6 Internal Tooth Steel Lockwasher	10 EA	
3.	129.5120.6511	1/8 X 3/16 Brass Eyelet	32 EA	
4.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
5.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
6.	4141.212.04	1 Inch Resistor Standoff	10 EA	
7.	4153.222.03	Slide Band And Knob Asm, 100W Res	1 EA	
8.	4153.222.04	Slide Band & Knob Asm, 25W, 50W Res	4 EA	
9.	4182.132.12	4-Way Tab Terminal	6 EA	
10.	4284.234.15	MXR-350 3P Filament Res Panel Blank	1 EA	
11.	733.1816.0242	18 Ga 1 Conductr Yellow Hookup Wire	1.20 FT	
12.	753.3501.51	1K 50W WW Adj Low T/C Resistor	2 EA	R1,R2
13.	753.3501.55	5K 50W Adjustable Low T/C Resistor	2 EA	R3,R4
14.	753.4101.4150	150.00R 100W WW Adj Low T/C Resistr	1 EA	R5

TABLE 5-22 Parts List for 5284.234.15
MXR-350 3P Filament Resistr Pnl Asm


XBR
XLO
XLU
XSO
XSU
N
UNDER TABLE SMALL FILAMENT SHUNT
OVER TABLE SMALL FILAMENT SHUNT
UNDER TABLE LARGE FILAMENT SHUNT
OVER TABLE LARGE FILAMENT SHUNT
FILAMENT BOOST SHUNT
R1 1K 50W
R2 1K 50W
R3 5K 50W
R4 5K 50W
R5 150Ω 100W

MXR-350 3P FILAMENT RESISTOR PNL ASM

FIGURE 5-43 SCHEMATIC FOR 5284.234.15

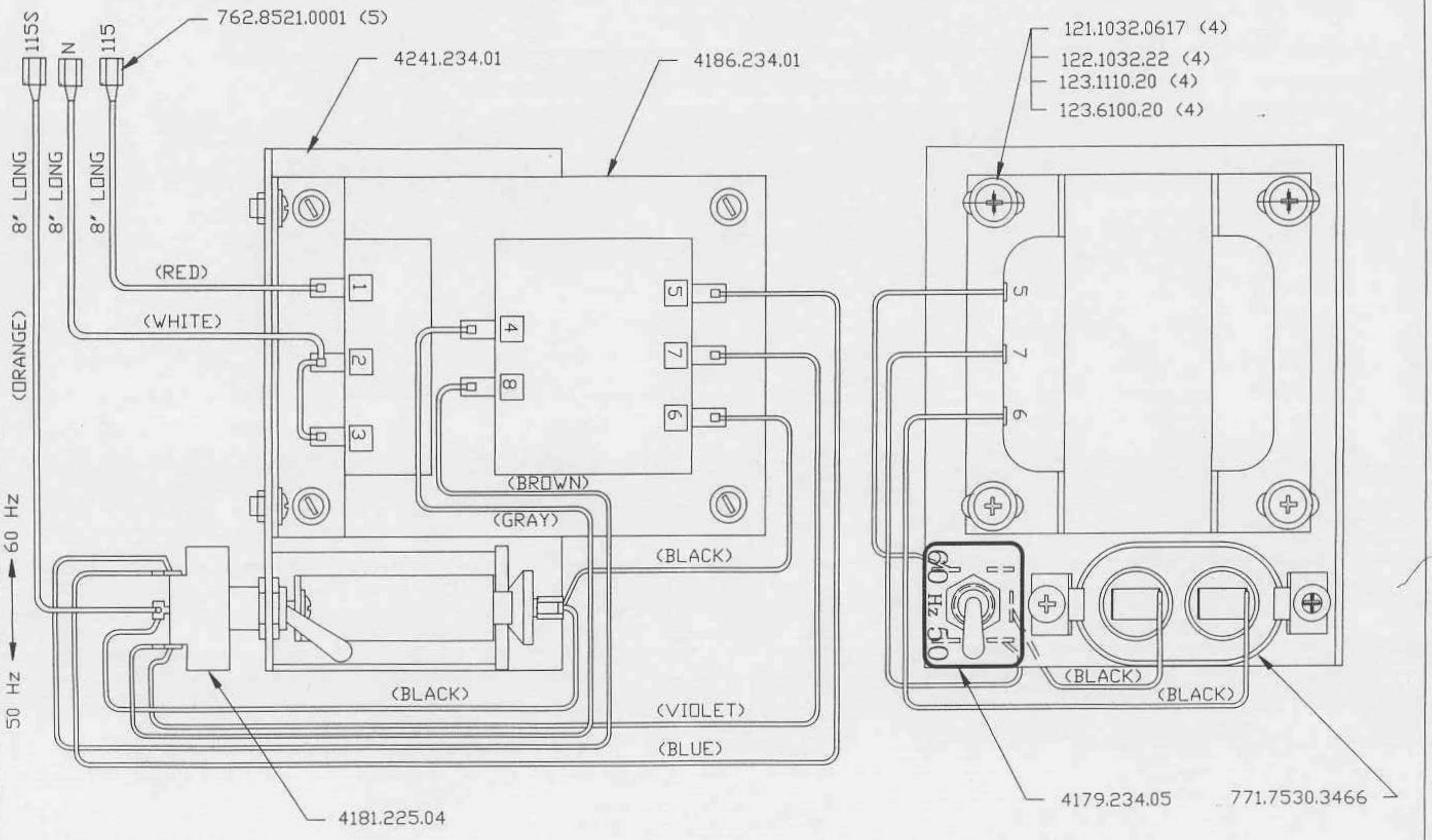

4247.230.13 (2)
4141.230.17 (2)
126.2080.6570 (4)
761.1562.10 (6)
761.1590.10
761.1590.20 (2)
761.1814
123.1306.20 (4)
123.4062.20 (4)
4178.230.02
126.2060.6570 (4)
4259.230.03
126.2060.6570 (16)
126.2060.6570 (4)
123.4062.20 (4)
115V N SR1 SR2 B E
5184.234.19
121.0632.0817 (2)
122.0632.22 (2)
123.1306.20 (2)
4259.230.02
4283.230.03
TOP VIEW WITHOUT RESISTOR
753.4101.3750
4152.085.02 (2)
191.3141.1040 (2)
126.2100.8570 (2)
SCALE 1=2

MXR-350 3P FILMNT DRIVE COOLING ASM

FIGURE 5-44 LAYOUT FOR 5285.234.01

	Part Number	Description	Quantity	Reference Designators
1.	121.0632.0817	6-32 X 1/2 Round Steel Philps Screw	2 EA	
2.	122.0632.22	6-32 Double Chamfered Hex Steel Nut	2 EA	
3.	123.1306.20	.1501D .3750D .032T Mach Scrw Washr	6 EA	
4.	123.4062.20	#6 Medium Pattern Split Lockwasher	8 EA	
5.	126.2060.6570	6B X 3/8 Phil Pan Head Steel Screw	24 EA	
6.	126.2080.6570	8B X 3/8 Pan Head Steel Screw	4 EA	
7.	126.2100.8570	10B X 1/2 Phil Pan Head Steel Screw	2 EA	
8.	191.3141.1040	10Z Type U Tinnerman Nut	2 EA	
9.	4141.230.17	Ci Cooling Tower Resistor Mtg Brkt	2 EA	
10.	4152.085.02	Resistor Standoff #12	2 EA	
11.	4178.230.02	421A 3X5X2 9/16 To-3 Heat Sink	1 EA	
12.	4247.230.13	2-5/8" Side Support Cooling Chimney	2 EA	
13.	4259.230.02	Fan&Heat Sink Sprt Cooling Chimney	1 EA	
14.	4259.230.03	Back Support Cooling Chimney	1 EA	
15.	4283.230.03	115 Volt .24 Amp 115Cfm Boxer Fan	1 EA	
16.	5184.234.19	MXR-350 Filament Drive Transtor Asm	1 EA	
17.	753.4101.3750	75.00R 100W WW Adj Low T/C Resistor	1 EA	
18.	761.1562.10	4-Way Medium Duty Terminal Block	6 EA	
19.	761.1590.10	Medium Terminal Block End	1 EA	
20.	761.1590.20	Channel Mounting Clamp	2 EA	
21.	761.1814.	14 Term Blank Terminal Channel	1 EA	

TABLE 5-23 Parts List for 5285.234.01
MXR-350 3P Filmnt Drive Cooling Asm

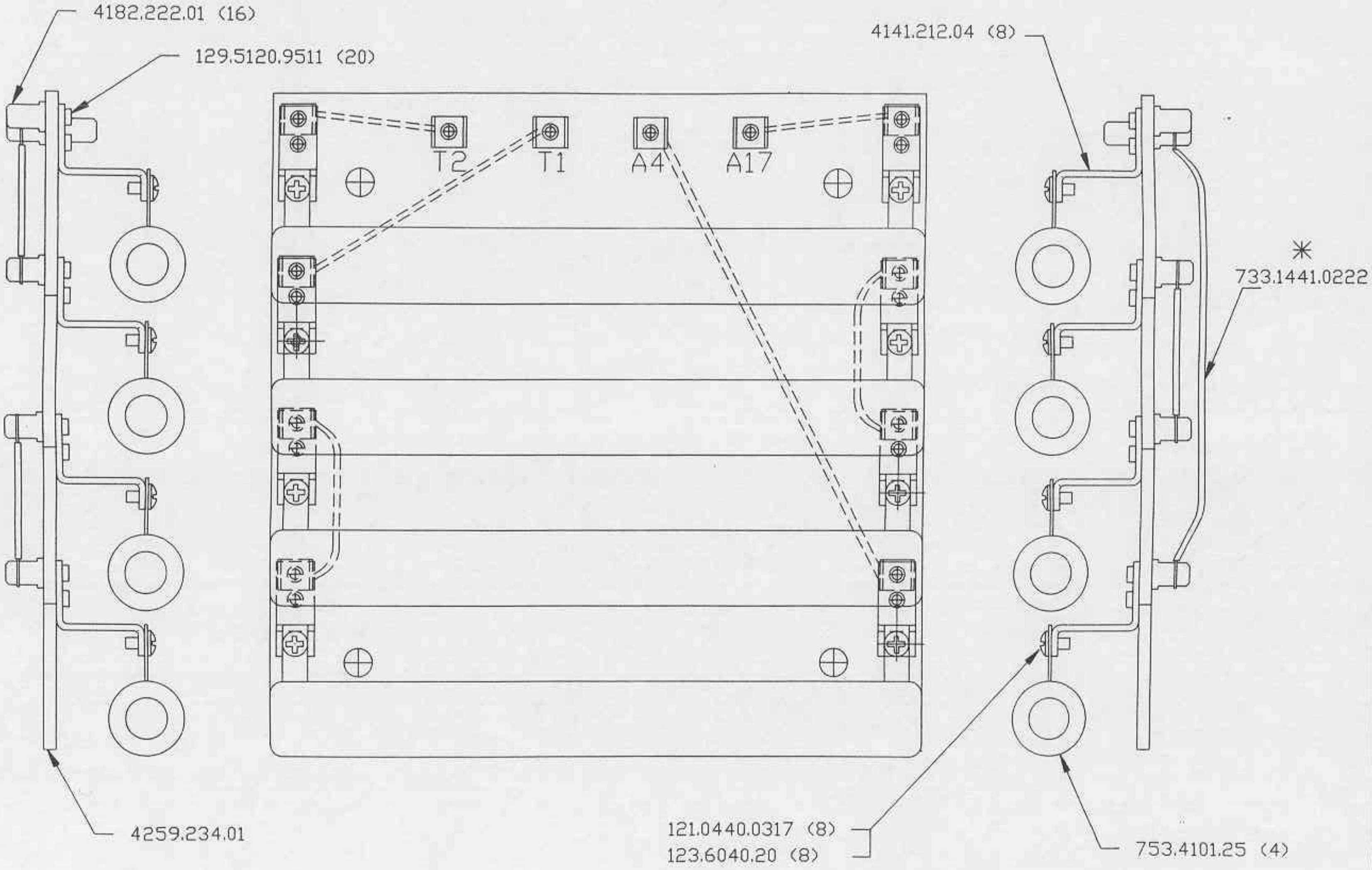

762.8521.0001 (5)
115S
N
115
8' LONG
8' LONG
8' LONG
(ORANGE)
(RED)
(WHITE)
4241.234.01
4186.234.01
1
2
3
4
8
5
7
6
(BROWN)
(GRAY)
(BLACK)
(BLACK)
(VIOLET)
(BLUE)
50 Hz
60 Hz
4181.225.04
121.1032.0617 (4)
122.1032.22 (4)
123.1110.20 (4)
123.6100.20 (4)
5
7
6
60 Hz 50
(BLACK)
(BLACK)
4179.234.05
771.7530.3466

CONSTANT VOLTAGE TRANSFORMER ASM

FIGURE 5-45 LAYOUT FOR 5285.234.02

	Part Number	Description	Quantity	Reference Designators
1.	121.1032.0617	10-32 X 3/8 Round Steel Phlps Screw	4 EA	
2.	122.1032.22	10-32 Double Chamfered Hex Nut Stl	4 EA	
3.	123.1110.20	7/32ID 1/2OD 3/64Thk Stl SAE Washer	4 EA	
4.	123.6100.20	#10 Internal Tooth Steel Lockwashr	4 EA	
5.	4179.234.05	MXR-350 Cnstnt Voltge Trnsfmr Label	1 EA	
6.	4181.235.04	2P 2T Tab Toggle Switch	1 EA	
7.	4186.234.01	C.V.T. 120VA 115/115V 50/60 Hz	1 EA	
8.	4241.234.01	MXR-350 CVT Mounting Bracket	1 EA	
9.	733.1816.0202	18 Ga 1 Conductor Black Hookup Wire	.90 FT	
10.	733.1816.0212	18 Ga 1 Conductor Brown Hookup Wire	.40 FT	
11.	733.1816.0222	18 Ga 1 Conductor Red Hookup Wire	.70 FT	
12.	733.1816.0232	18 Ga 1 Conductr Orange Hookup Wire	.70 FT	
13.	733.1816.0262	18 Ga 1 Conductor Blue Hookup Wire	.70 FT	
14.	733.1816.0272	18 Ga 1 Conductr Violet Hookup Wire	.70 FT	
15.	733.1816.0282	18 Ga 1 Conductor Gray Hookup Wire	.40 FT	
16.	733.1816.0292	18 Ga 1 Conductor White Hookup Wire	.70 FT	
17.	762.8521.0001	.250 #18 Female Cont Strip Tab Term	5 EA	
18.	771.7530.3466	3 Mfd 660 VAC Capacitor	1 EA	

TABLE 5-24 Parts List for 5285.234.02
Constant Voltage Transformer Asm


4182.222.01 (16)
129.5120.9511 (20)
4141.212.04 (8)
T2
T1
A4
A17
733.1441.0222
4259.234.01
121.0440.0317 (8)
123.6040.20 (8)
753.4101.25 (4)

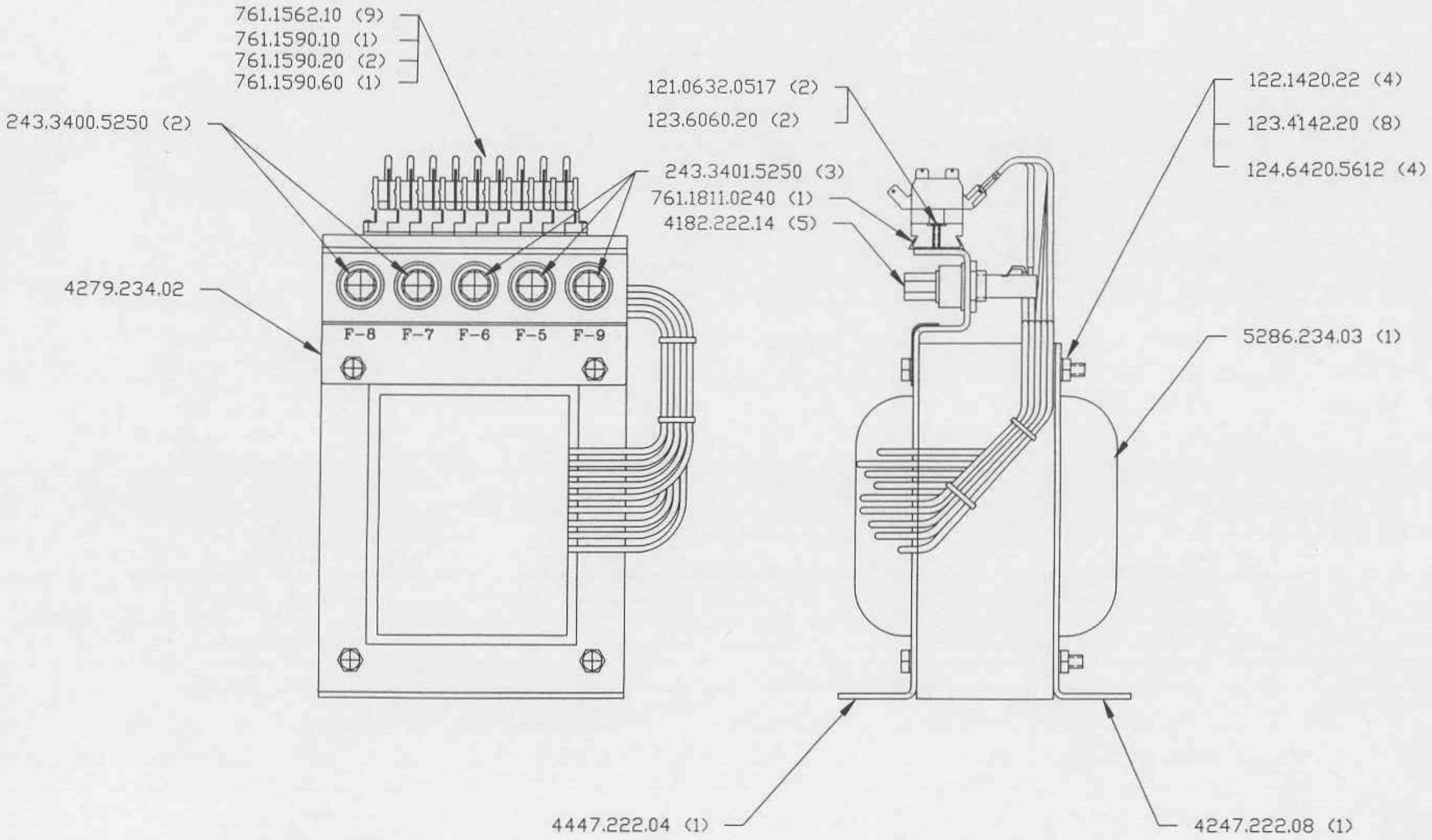
MXR-350 RESISTOR PANEL ASM

FIGURE 5-46 LAYOUT FOR 5285.234.03

✳ WRAP ENDS OF THE WIRES AROUND TERMINALS
4182.222.01 BEFORE SOLDERING

	Part Number	Description	Quantity	Reference Designators
1.	121.0440.0317	4-40 X 3/16 Round Steel Phlps Screw	8 EA	
2.	123.6040.20	#4 Internal Tooth Steel Lockwasher	8 EA	
3.	129.5120.9511	1/8 X 9/32 Brass Eyelet	20 EA	
4.	4111.234.01	MXR-350 Resistor Pnl Mntng Bushing	4 EA	
5.	4141.212.04	1 Inch Resistor Standoff	8 EA	
6.	4182.222.01	Double Tab Terminal	16 EA	
7.	4259.234.01	MXR 350 Resistor Panel	1 EA	
8.	733.1441.0222	14 Ga 1 Conductor Red Hookup Wire	1.70 FT	
9.	753.4101.25	5.00R 100W WW Adj Low T/C Resistor	4 EA	

TABLE 5-25 Parts List for 5285.234.03
MXR-350 Resistor Panel Asm


761.1562.10 (9)
761.1590.10 (1)
761.1590.20 (2)
761.1590.60 (1)
243.3400.5250 (2)
4279.234.02
F-8
F-7
F-6
F-5
F-9
121.0632.0517 (2)
123.6060.20 (2)
243.3401.5250 (3)
761.1811.0240 (1)
4182.222.14 (5)
122.1420.22 (4)
123.4142.20 (8)
124.6420.5612 (4)
5286.234.03 (1)
4447.222.04 (1)
4247.222.08 (1)

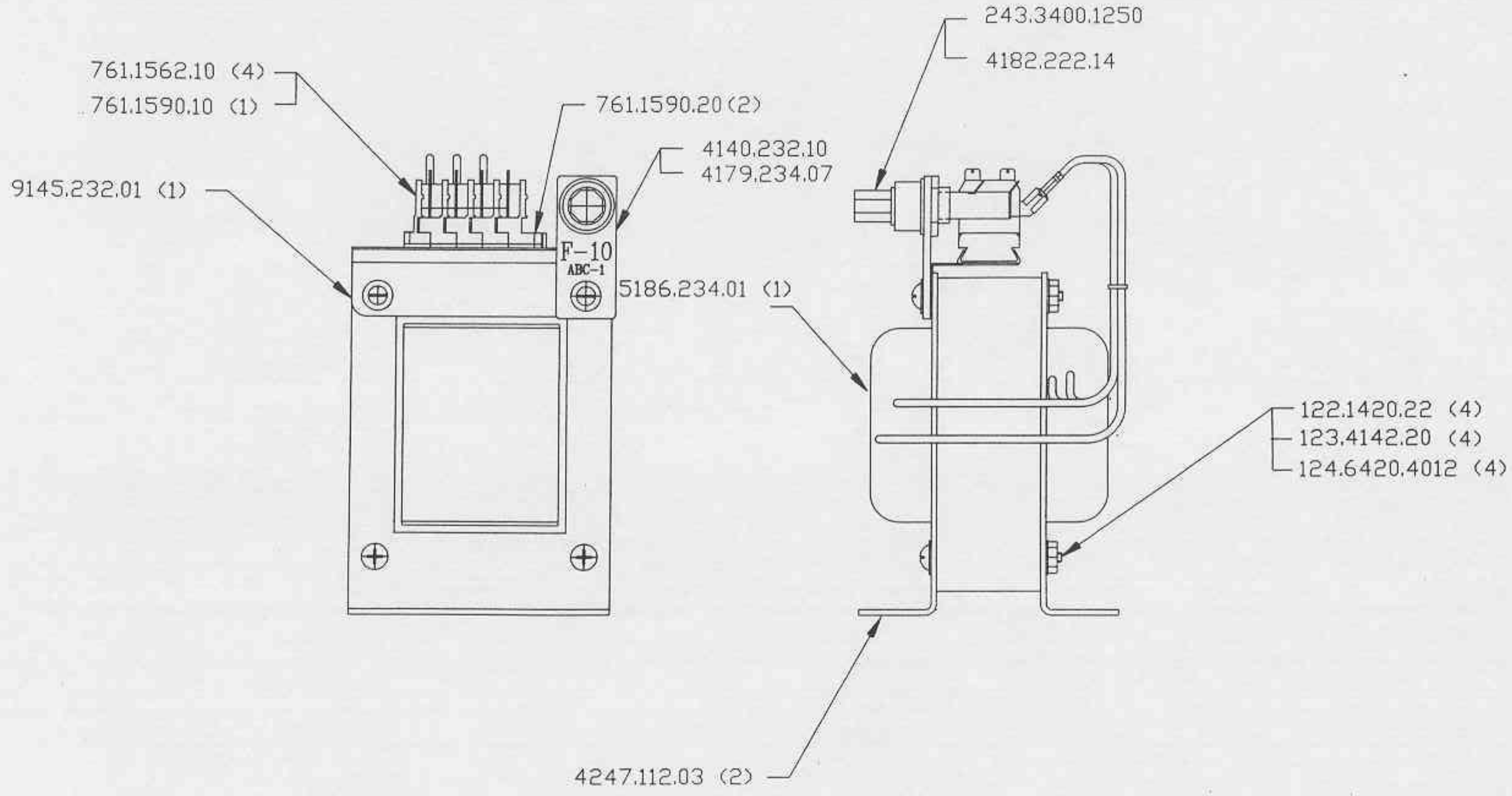
AUX PWR SUPPLY 50/60 Hz XFMR ASM

FIGURE 5-47 LAYOUT FOR 5286.234.04

SCALE 1=2

	Part Number	Description	Quantity	Reference Designators
1.	121.0632.0517	6-32 X 5/16 Round Steel Phlps Screw	2 EA	
2.	122.1420.22	1/4-20 Double Chamfered Stl Hex Nut	4 EA	
3.	123.4142.20	1/4 Medium Pattern Split Lockwasher	8 EA	
4.	123.6060.20	#6 Internal Tooth Steel Lockwasher	2 EA	
5.	124.6420.5612	1/4-20 X 3-1/2 Hex Head Cap Screw	4 EA	
6.	243.3400.5250	5.0 Amp 250 Volt Tubular Fuse	2 EA	
7.	243.3401.5250	15 Amp 250 Volt Tubular Fuse	3 EA	
8.	4182.222.14	Fuse Holder And Indicator	5 EA	
9.	4247.222.08	201 Auto Rear Core Clamp	1 EA	
10.	4279.234.02	MXR-350 Aux Trnsfrmr Fuses Label	1 EA	
11.	4447.222.04	Auto Core Clamp And Fuse Mount	1 EA	
12.	5286.234.03	Wkfld Aux Pwr Xfmr Core Ass'y	1 EA	
13.	761.1562.10	4-Way Medium Duty Terminal Block	9 EA	
14.	761.1590.10	Medium Terminal Block End	1 EA	
15.	761.1590.20	Channel Mounting Clamp	2 EA	
16.	761.1590.60	Nylon Holding Plug	1 EA	
17.	761.1811.0240	11 Term 2 Hole Terminal Channel	1 EA	

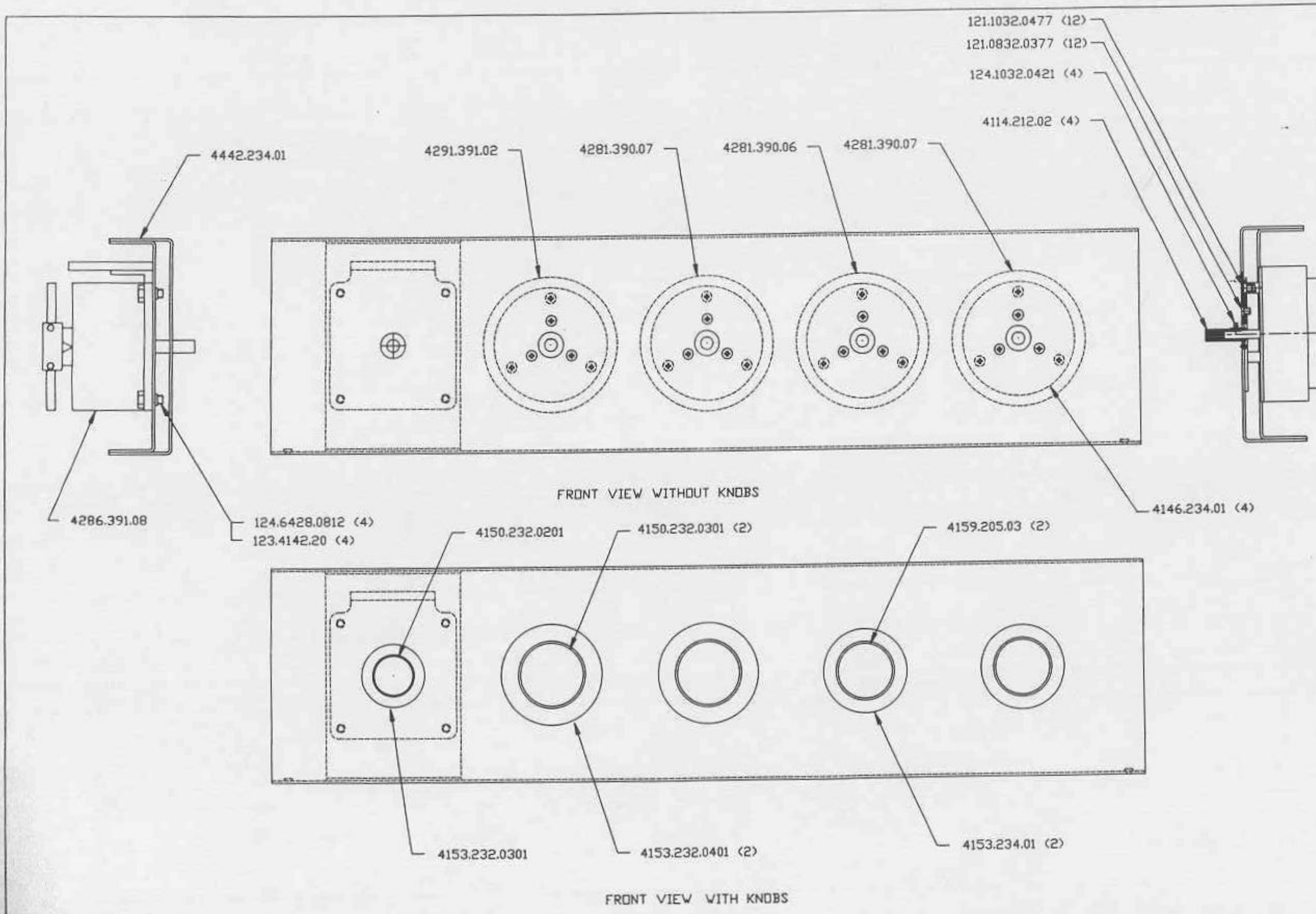
TABLE 5-26 Parts List for 5286.234.04
Aux Pwr Supply 50/60Hz Xfmr Asm


761.1562.10 (4)
761.1590.10 (1)
9145.232.01 (1)
761.1590.20 (2)
4140.232.10
4179.234.07
F-10
ABC-1
5186.234.01 (1)
243.3400.1250
4182.222.14
122.1420.22 (4)
123.4142.20 (4)
124.6420.4012 (4)
4247.112.03 (2)

FIL. XFMR SUPPLY ASM 50/60 Hz
FIGURE 5-48 LAYOUT FOR 5286.234.05

	Part Number	Description	Quantity	Reference Designators
1.	122.1420.22	1/4-20 Double Chamfered Stl Hex Nut	4 EA	
2.	123.4142.20	1/4 Medium Pattern Split Lockwasher	4 EA	
3.	124.6420.4012	1/4-20 X 2-1/2 Hex Head Cap Screw	4 EA	
4.	243.3400.1250	1 Amp 250 Volt Tubular Fuse	1 EA	
5.	4140.232.10	Concorde Filament Fuse Mount Brkt	1 EA	
6.	4179.234.07	MXR-350 Filament Trnsfmr Fuse Label	1 EA	
7.	4182.222.14	Fuse Holder And Indicator	1 EA	
8.	4247.112.03	1-3/4 E.I Core Clamp	2 EA	
9.	5186.234.01	Fil.Transf. Supply Core&Coil Assy	1 EA	
10.	761.1562.10	4-Way Medium Duty Terminal Block	4 EA	
11.	761.1590.10	Medium Terminal Block End	1 EA	
12.	761.1590.20	Channel Mounting Clamp	2 EA	
13.	9145.232.01	Concorde Flmnt Cntrl Xfmr TS Brkt	1 EA	

TABLE 5-27 Parts List for 5286.234.05
Fil. Xfmr Supply Asm 50/60Hz


121.1032.0477 (12)
121.0832.0377 (12)
124.1032.0421 (4)
4114.212.02 (4)
4442.234.01
4291.391.02
4281.390.07
4281.390.06
4281.390.07
FRONT VIEW WITHOUT KNOBS
4146.234.01 (4)
4286.391.08
124.6428.0812 (4)
123.4142.20 (4)
4150.232.0201
4150.232.0301 (2)
4159.205.03 (2)
4153.232.0301
4153.232.0401 (2)
4153.234.01 (2)
FRONT VIEW WITH KNOBS

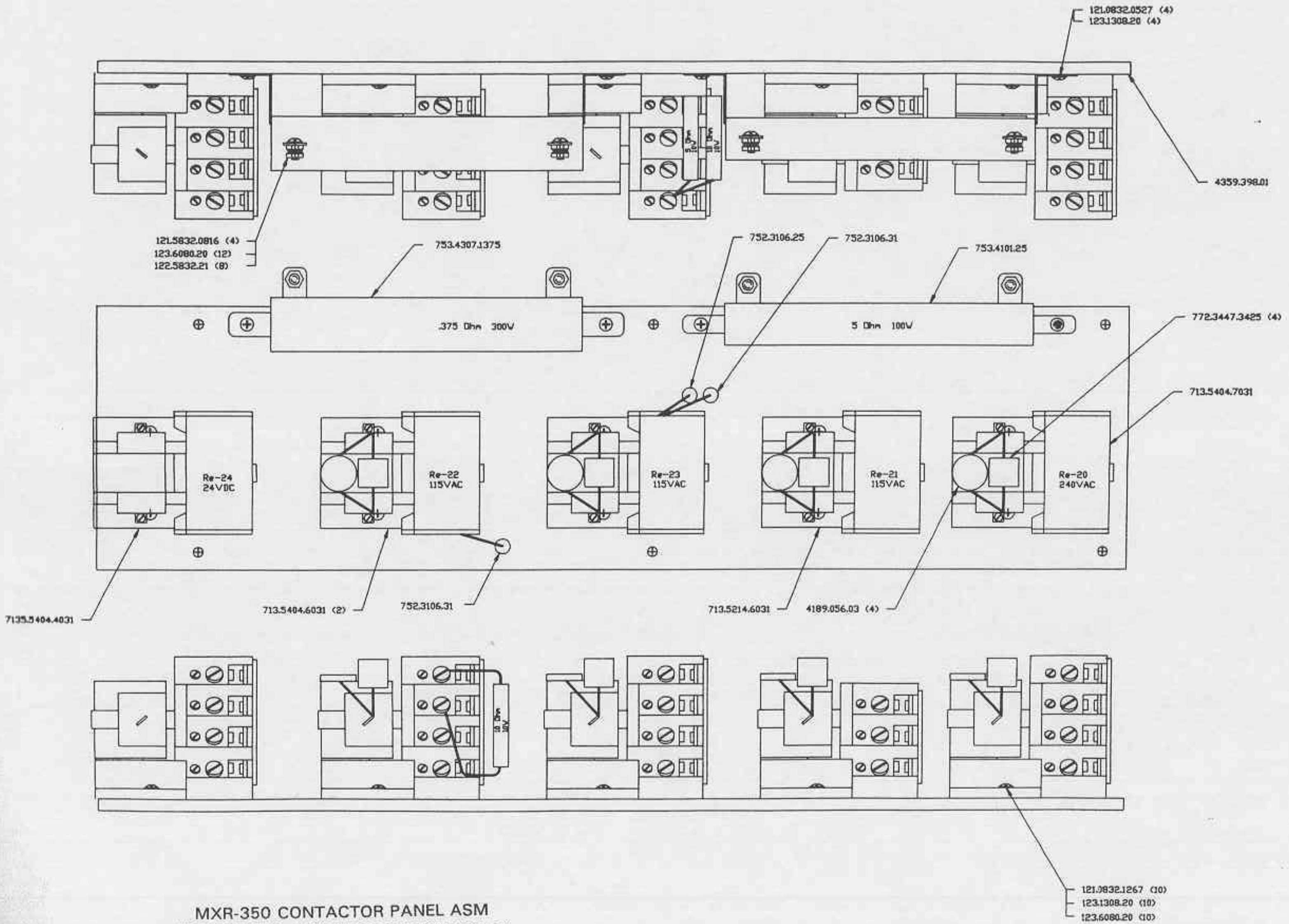
SCALE 1=2

MXR-350 TAP SWITCHES PANEL ASM

FIGURE 5-49 LAYOUT FOR 5485.234.01

	Part Number	Description	Quantity		Reference Designators
1.	121.0832.0377	8-32 X 3/16 Flat Undercut Stl Scrw	12	EA	
2.	121.1032.0477	10-32 X 1/4 Flat Undercut Stl Screw	12	EA	
3.	123.4142.20	1/4 Medium Pattern Split Lockwasher	4	EA	
4.	124.1032.0421	10-32 X 1/4 Sckt Hd Set Scrw Cup Pt	4	EA	
5.	124.6428.0812	1/4-28 X 1/2 Hex Head Cap Screw	4	EA	
6.	4114.212.02	1/4 To 3/8 Switch Shaft	4	EA	
7.	4146.234.01	Tap Switch Adaptor Disc	4	EA	
8.	4150.232.0201	CXF-1000 1.10 Dia Med Gray Disc	1	EA	
9.	4150.232.0301	CXF-1000 2.06 Dia Med Gray Disc	2	EA	
10.	4153.232.0301	CXC 3/8 Hole 1-7/8 OD Gray Knob	1	EA	
11.	4153.232.0401	CXC 3/8 Hole 3 OD Gray Knob	2	EA	
12.	4153.234.01	CXC 3/8 Hole 2-1/2 OD Gray Knob	2	EA	
13.	4159.205.03	1.562" Dia. Dark Gray Knob Insert	2	EA	
14.	4281.390.06	50A-300V 6 Pos Tap Switch	1	EA	
15.	4281.390.07	50 Amp 300 V 7 Position Tap Switch	2	EA	
16.	4281.391.02	50 Amp 12 Point Tap Switch	1	EA	
17.	4286.391.08	0-140V 5A Variable Autotransformer	1	EA	
18.	4442.234.01	Concord Switch Panel	1	EA	

TABLE 5-28 Parts List for 5485.234.01
MXR-350 Tap Switches Panel Asm



121.0832.0527 (4)
123.1308.20 (4)
4359.398.01
121.5832.0816 (4)
123.6080.20 (12)
122.5832.21 (8)
753.4307.1375
752.3106.25
752.3106.31
753.4101.25
5 Ohm 10V
10 Ohm 10V
.375 Ohm 300V
5 Ohm 100W
772.3447.3425 (4)
713.5404.7031
Re-24 24VDC
Re-22 115VAC
Re-23 115VAC
Re-21 115VAC
Re-20 240VAC
7135.5404.4031
713.5404.6031 (2)
752.3106.31
713.5214.6031
4189.056.03 (4)
10 Ohm 10V
121.0832.1267 (10)
123.1308.20 (10)
123.6080.20 (10)

MXR-350 CONTACTOR PANEL ASM
FIGURE 5-50 LAYOUT FOR 5585.234.02

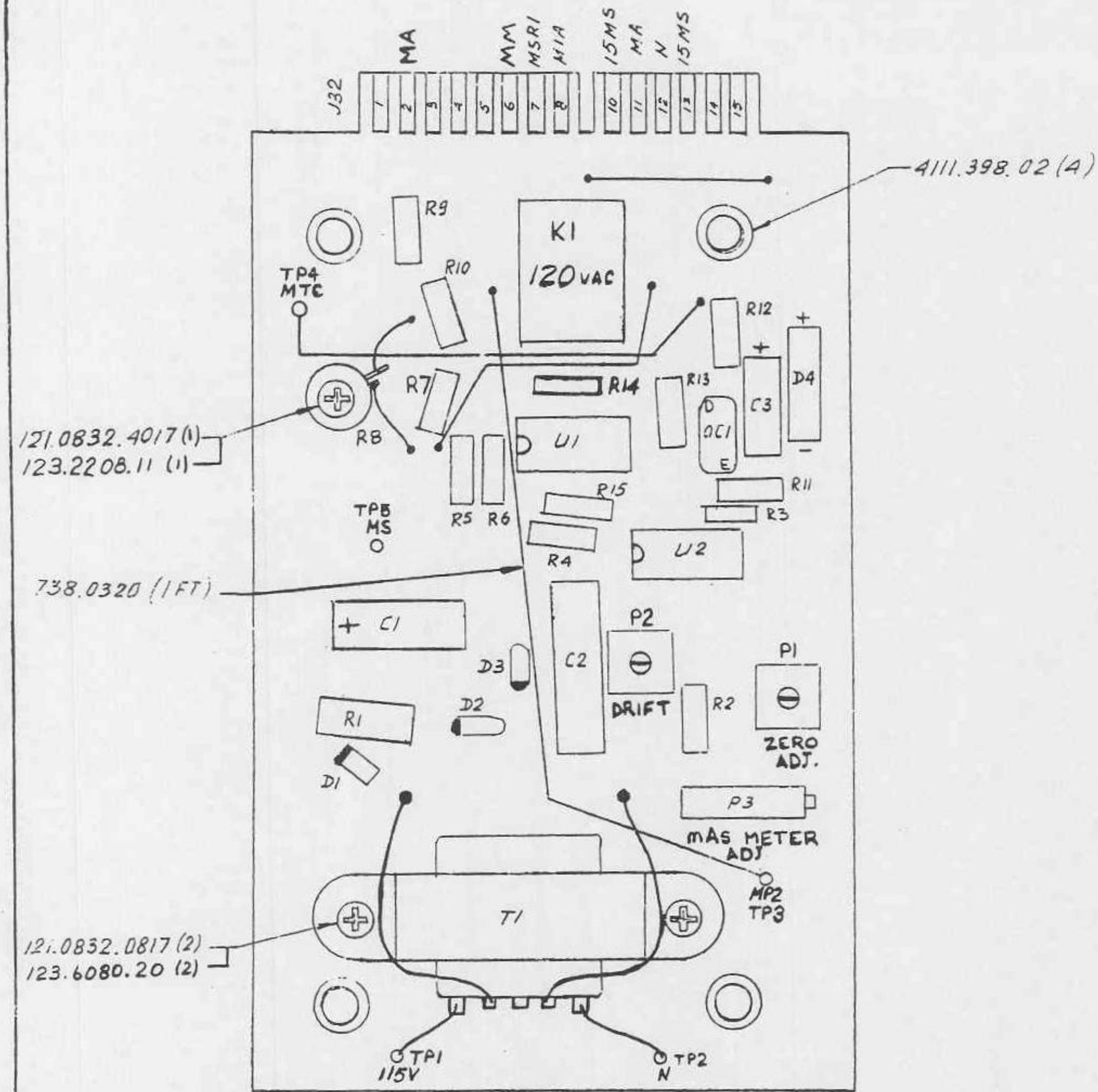
	Part Number	Description	Quantity	Reference Designators
1.	121.0832.0527	8-32 X 5/16 Flat Steel Philps Screw	4 EA	
2.	121.0832.1257	8-32 X 3/4 Pan Steel Phillips Screw	10 EA	
3.	121.5832.0816	8-32 X 1/2 Brass Phil Rd Head Screw	4 EA	
4.	122.5832.21	8-32 Brass Double Chamfered Hex Nut	8 EA	
5.	123.1308.20	.170Id .3750d .032T Mach Scrw Washr	14 EA	
6.	123.6080.20	#8 Internal Tooth Steel Lockwasher	22 EA	
7.	4182.071.01	22-18 X 4 Uninsulated Ring Terminal	36 EA	
8.	4182.122.09	10 X 22 & 16 Ring Terminal	9 EA	
9.	4182.122.10	16 & 14 X 10 Ring Terminal	7 EA	
10.	4189.056.03	Thyrector Diode 125 Volt	4 EA	
11.	4359.398.01	Barton Contactor Mounting Panel	1 EA	
12.	713.5214.6031	Furnas 40 Amp 201C 115 Vac Relay	1 EA	
13.	713.5404.4031	Furnas 40 Amp 4PNO 24 Volt AC Relay	1 EA	
14.	713.5404.6031	Furnas 40 Amp 4PNO 115 VAC Relay	2 EA	
15.	713.5404.7031	Furnas 40 Amp 4PNO 230 Vac Relay	1 EA	
16.	733.0871.0212	8 Ga 1 Conductor Black Hookup Wire	18 FT	
17.	733.1441.0202	14 Ga 1 Conductor Black Hookup Wire	1.80 FT	
18.	733.1441.0212	14 Ga 1 Conductor Brown Hookup Wire	2 FT	
19.	733.1441.0222	14 Ga 1 Conductor Red Hookup Wire	23.50 FT	
20.	733.1441.0232	14 Ga 1 Conductr Orange Hookup Wire	.70 FT	
21.	733.1441.0272	14 Ga 1 Conductr Violet Hookup Wire	2.70 FT	
22.	733.1816.0222	18 Ga 1 Conductor Red Hookup Wire	1.80 FT	
23.	733.1816.0232	18 Ga 1 Conductr Orange Hookup Wire	3.20 FT	
24.	733.1816.0262	18 Ga 1 Conductor Blue Hookup Wire	5.40 FT	
25.	733.1816.0272	18 Ga 1 Conductr Violet Hookup Wire	1.80 FT	
26.	733.1816.0282	18 Ga 1 Conductor Gray Hookup Wire	3.20 FT	

. . . continued on next page

TABLE 5-29 Parts List for 5585.234.02
MXR 350 Contactor Panel Asm

	Part Number	Description	Quantity	Reference Designators
27.	733.1816.0292	18 Ga 1 Conductor White Hookup Wire	2 FT	
28.	752.3106.25	5R 10W 5% Fixed WW Low T/C Resistor	1 EA	
29.	752.3106.31	10R 10W 5% Fxd WW Low T/C Resistor	2 EA	
30.	753.4101.25	5.00R 100W WW Adj Low T/C Resistor	1 EA	
31.	753.4307.1375	.375R 300W 10% Rib Wnd Adj Resitor	1 EA	
32.	772.3447.3425	.47 Mfd 250 VAC Metalized Paper Cap	4 EA	

TABLE 5-29 Parts List for 5585.234.02
MXR 350 Contactor Panel Asm


J32
1
2
3
4
5
6
7
8
10
11
12
13
14
15
MA
MM
MSRI
MIA
15MS
MA
N
15MS
4111.398.02 (A)
R9
K1
120VAC
R10
TP4
MTC
R12
+
+
D4
R7
R14
R13
C3
OC1
D
E
−
121.0832.4017 (1)
123.2208.11 (1)
R8
U1
R5
R6
R15
R11
R3
TPB
MS
R4
U2
738.0320 (1FT)
C1
+
P2
P1
D3
C2
DRIFT
R2
D2
R1
ZERO
ADJ.
D1
P3
mAs METER
ADJ
MP2
TP3
T1
121.0832.0817 (2)
123.6080.20 (2)
TP1
115V
TP2
N

MXR-350 mAs METER CURRENT INTEGRATOR ASM

FIGURE 5-51 LAYOUT FOR 6184.234.0803

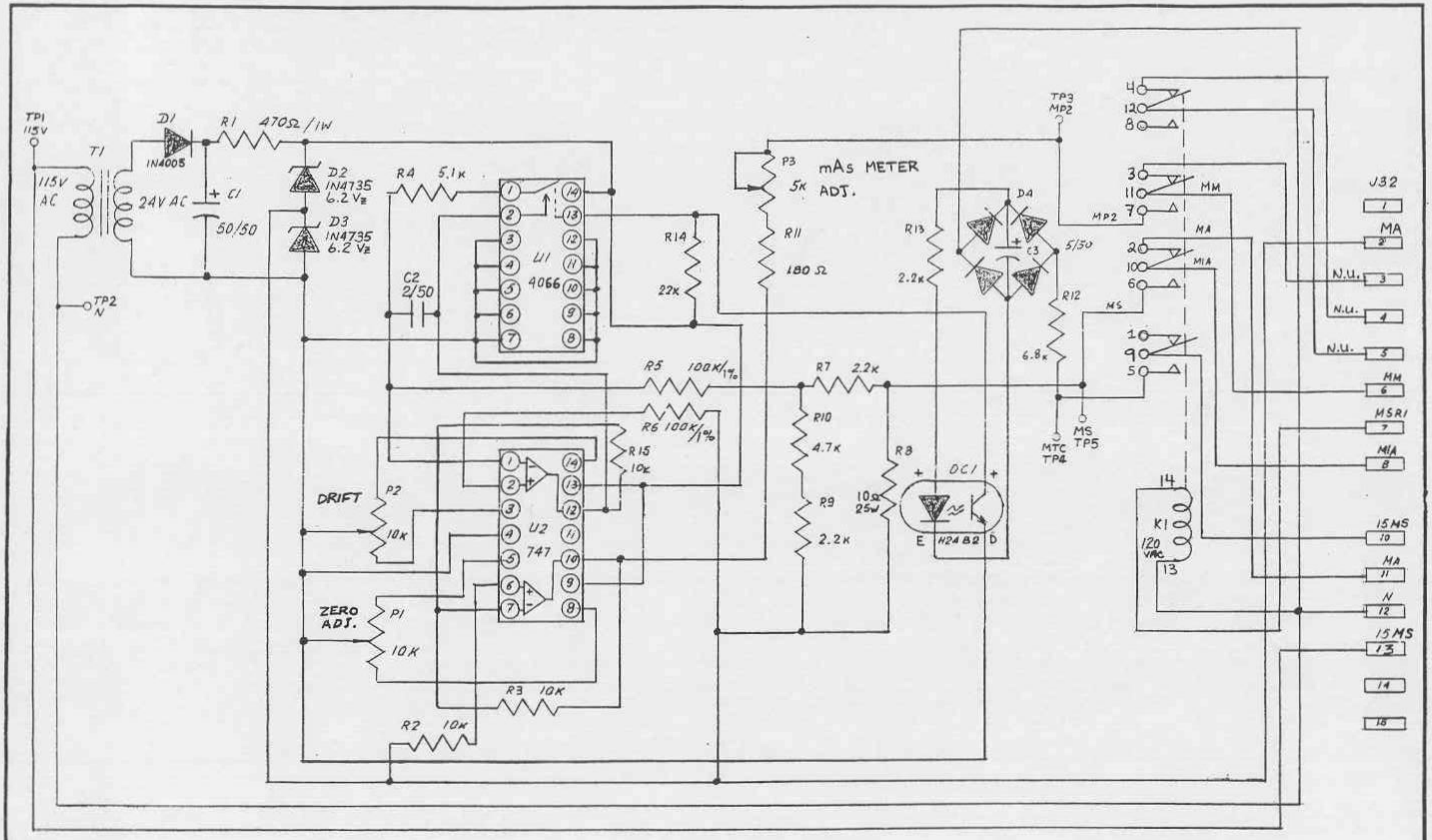
	Part Number	Description	Quantity	Reference Designators
1.	121.0832.0817	8-32 X 1/2 Round Steel Philps Screw	2 EA	
2.	121.0832.4017	8-32 X 2-1/2 Round Steel Phlp Screw	1 EA	
3.	123.2208.11	.171 ID .500 OD .070Thk.Brass Wash.	1 EA	
4.	123.6080.20	#8 Internal Tooth Steel Lockwasher	2 EA	
5.	135.3416.01	#16 Teflon Insulating Tubing	1.30 FT	
6.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
7.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
8.	4118.122.02	8-32 X 7/16 Fh A Rivnut	3 EA	
9.	4184.234.0803	MXR-350 mAs Current Intgrtr PC Blnk	1 EA	
10.	4186.331.05	115 To 24Ct 0.2A Volt Transformer	1 EA	T1
11.	714.4371.1221	4PDT 120 Volt AC Mini Relay	1 EA	K1
12.	714.9001.	4PDT Mini Relay Pc Socket	1 EA	
13.	714.9002.	Relay Hold-Down Spring	1 EA	
14.	738.0320.	20 Awg Solid Tinned Copper Wire	1.50 FT	
15.	751.1504.71	100K 1/2 Watt 1% Carbon Resistor	2 EA	R5,R6
16.	751.1506.4180	180R 1/2 Watt 5% Carbon Resistor	1 EA	R11
17.	751.1506.5220	2.2K 1/2 Watt 5% Carbon Resistor	3 EA	R7,R9,R13
18.	751.1506.5470	4.7K 1/2 Watt 5% Carbon Resistor	1 EA	R10
19.	751.1506.5510	5.1K 1/2 Watt 5% Carbon Resistor	1 EA	R4
20.	751.1506.61	10K 1/2 Watt 5% Carbon Resistor	3 EA	R2,R3,R15
21.	751.1506.6220	22K 1/2 Watt 5% Carbon Resistor	1 EA	R14
22.	751.2106.4470	470R 1 Watt 5% Carbon Resistor	1 EA	R1
23.	751.2106.5680	6.8K 1 Watt 5% Carbon Resistor	1 EA	R12
24.	753.3251.31	10.00R 25W WW Adj Low T/C Resistor	1 EA	R8
25.	754.1506.1009	1/2 Watt 10K Sub Min Potentiometer	2 EA	P1,P2
26.	754.1755.5007	3/4 Watt 5K Trimmer Potentiometer	1 EA	P3

. . . continued on next page

TABLE 5-30 Parts List for 6184.234.0803
MXR-350 mAs Mtr Current Intgrtr Asm

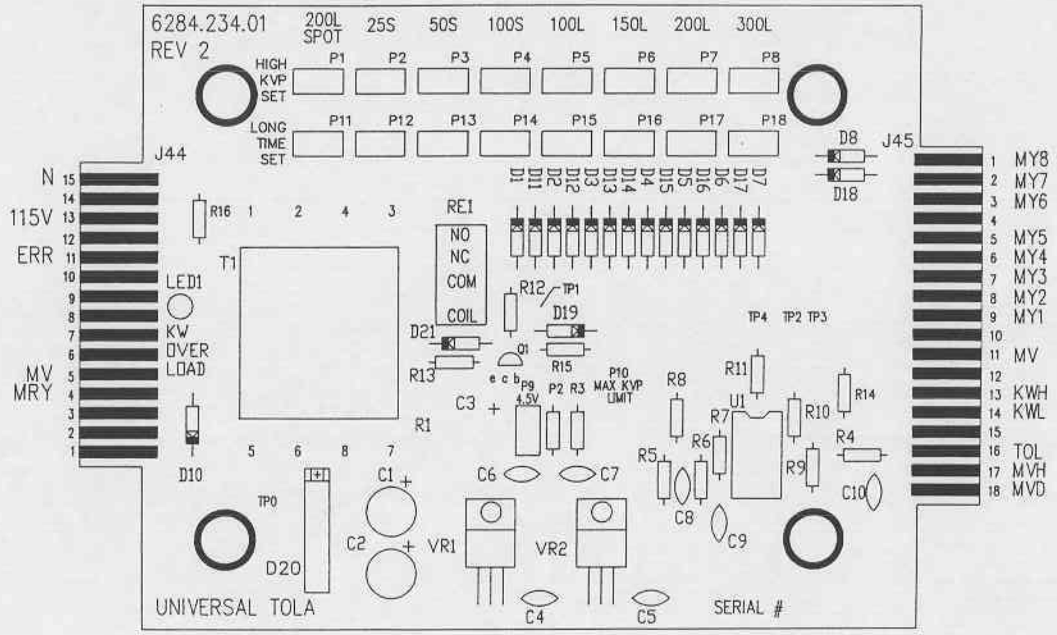
	Part Number	Description	Quantity	Reference Designators
27.	764.1020.10	Cambion Type K 2085-02 PC Terminal	5 EA	TP1-TP5
28.	771.1550.2350	5 Mfd 50 Volt Elctlt Capacitor	1 EA	C3
29.	771.1650.1350	50 Mfd 50 Volt DC Elctyc Capacitor	1 EA	C1
30.	773.1520.4350	2 Mfd 50 Volt #1 Mylar Capacitor	1 EA	C2
31.	781.3205.6006	600 PIV 2.0 Amp FW Bridge Rectifier	1 EA	D4
32.	782.1040.05	1N4005 1A 600V Silicon Rectifier	1 EA	D1
33.	782.1047.35	1N4735 6.2 Volt Zener Diode	2 EA	D2,D3
34.	786.1223.7472	747A Op Amp 14 DIP Ceramic Hi Temp	1 EA	U2
35.	786.3223.66	4066 CMOS Switch Ceramic High Temp	1 EA	U1
36.	786.9107.7012	H24B2 Darlington Opto-Coupler	1 EA	OC1

TABLE 5-30 Parts List for 6184.234.0803
MXR-350 mAs Mtr Current Intgrtr Asm


TP1
115V
115V
AC
T1
TP2
N
D1
1N4005
24V AC
+ C1
50/50
R1 470Ω/1W
D2
1N4735
6.2 Vz
D3
1N4735
6.2 Vz
R4 5.1K
C2
2/50
U1
4066
R14
22K
DRIFT
P2
10K
ZERO
ADJ.
P1
10K
U2
747
R15
10K
R5 100K/1%
R6 100K/1%
R3 10K
R2 10K
P3
5K
mAs METER
ADJ.
R11
180 Ω
R7 2.2K
R10
4.7K
R9
2.2K
R8
10Ω
25W
R13
2.2K
D4
C3
5/50
R12
6.8K
OC1
H24B2
E
D
TP3
MP2
MP2
MTC
TP4
MS
TP5
MS
MA
MIA
MM
K1
120
VAC
14
13
J32
1
MA 2
N.U. 3
N.U. 4
N.U. 5
MM 6
MSR1 7
MIA 8
15MS 10
MA 11
N 12
15MS 13
14
15

MXR-350 mAs METER CURRENT INTEGRATOR ASM
FIGURE 5-52 SCHEMATIC FOR 6184.234.0803

DIETZGEN NO. 199M AGEPROOF NO. 216.13


6284.234.01
REV 2
200L SPOT
25S
50S
100S
100L
150L
200L
300L
HIGH KVP SET
P1
P2
P3
P4
P5
P6
P7
P8
LONG TIME SET
P11
P12
P13
P14
P15
P16
P17
P18
J44
J45
D8
D18
N
115V
ERR
MV
MRY
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
R16
1
2
4
3
T1
RE1
NO
NC
COM
COIL
D1
D11
D2
D12
D3
D13
D14
D4
D15
D5
D16
D6
D17
D7
LED1
KW OVER LOAD
R12
TP1
D19
D21
Q1
R13
R15
e c b
P9 4.5V
P2
R3
P10 MAX KVP LIMIT
C3
R1
R8
R11
TP4
TP2
TP3
R7
U1
R10
R14
R6
R4
R5
R9
5
6
8
7
D10
C1
C6
C7
C10
TP0
C8
C9
C2
VR1
VR2
D20
UNIVERSAL TOLA
C4
C5
SERIAL #
1 MY8
2 MY7
3 MY6
4
5 MY5
6 MY4
7 MY3
8 MY2
9 MY1
10
11 MV
12
13 KWH
14 KWL
15
16 TOL
17 MVH
18 MVD

MXR-350 UNIVERSAL TOLA ASSEMBLY

FIGURE 5-53 LAYOUT FOR 6284.234.01

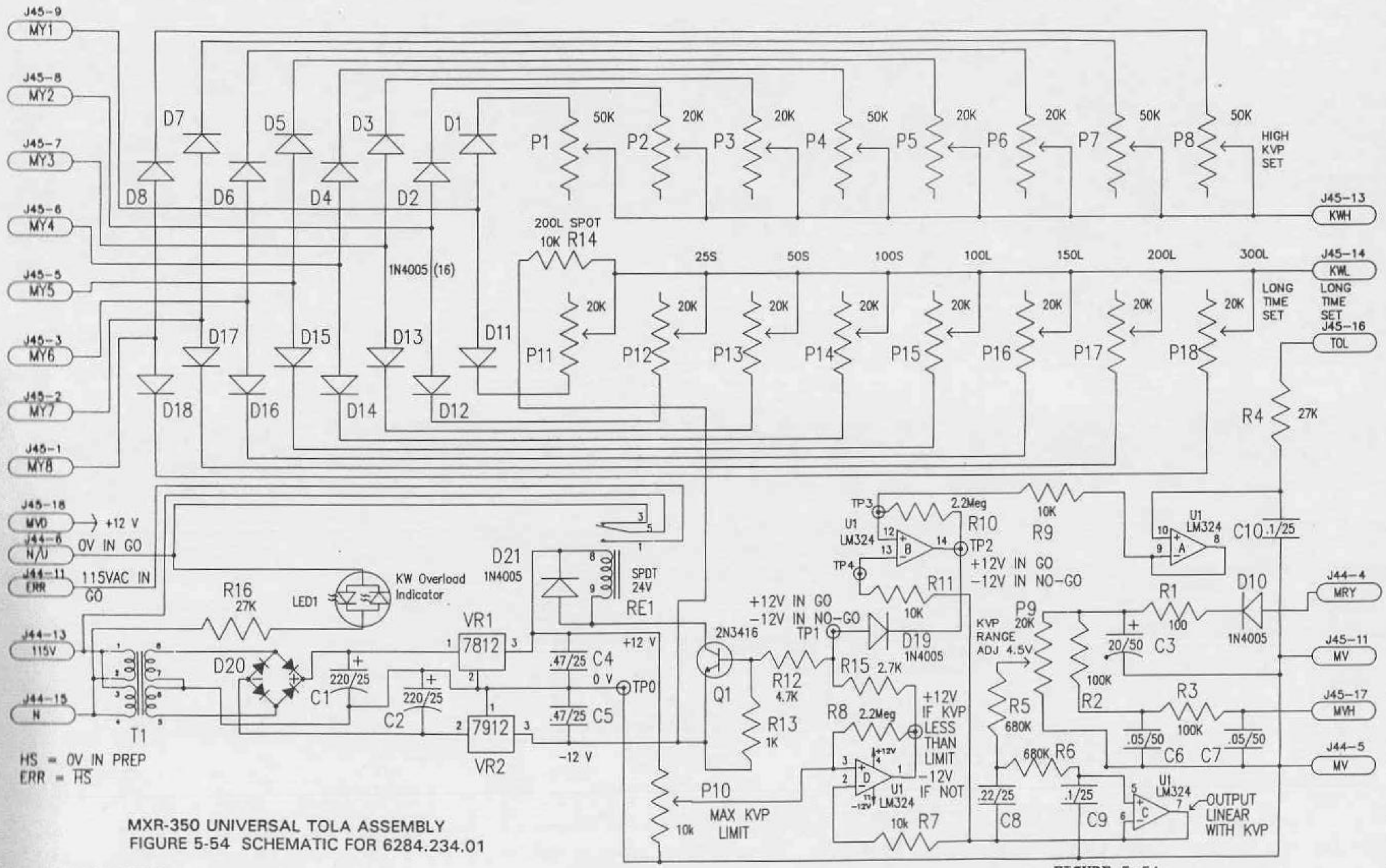
	Part Number	Description	Quantity	Reference Designators
1.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
3.	4186.060.01	115/230 X 24V CT @250Ma Flt PC Xfmr	1 EA	T1
4.	4284.234.01	Universal TOLA Assembly PC Blank	1 EA	
5.	714.2668.1621	0.5 Amp DPDT 24 VDC DIP Relay	1 EA	RE1
6.	751.1256.41	100 Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R1
7.	751.1256.51	1.0K 1/4 Watt 5% Carbon Resistor	1 EA	R13
8.	751.1256.5270	2.7K 1/4 Watt 5% Carbon Resistor	1 EA	R15
9.	751.1256.5470	4.7K 1/4 Watt 5% Carbon Resistor	1 EA	R12
10.	751.1256.61	10K Ohm 1/4 Watt 5% Carbon Resistor	4 EA	R7,R9,R11,R14
11.	751.1256.6270	27K Ohm 1/4 Watt 5% Carbon Resistor	2 EA	R4,R16
12.	751.1256.71	100K Ohm 1/4 Watt 5% Carbon Resistr	2 EA	R2,R3
13.	751.1256.7680	680K Ohm 1/4 Watt 5% Carbon Resistr	2 EA	R5,R6
14.	751.1256.8220	2.2M 1/4W 5% Carbon Resistor	2 EA	R8,R10
15.	754.1506.1011	1/2W 10K 20T Vert Adj 3/8 Sq Potmtr	1 EA	P10
16.	754.1506.2011	1/2W 20K 20T Vert Adj 3/8 Sq Potmtr	13 EA	P2,P3,P5,P6, P9,P11-P18
17.	754.1506.5011	1/2W 50K 20T Vert Adj 3/8 Sq Potmtr	4 EA	P1,P4,P7,P8
18.	764.1020.10	Cambion Type K 2085-02 PC Terminal	5 EA	TP0-TP4
19.	771.5622.0350	22 Mfd 50WVDC Radial Elect. Cap	1 EA	C3
20.	771.5722.0325	220Mfd 25V Radial Electroltic Cap.	2 EA	C1,C2
21.	776.3350.1450	.05 Mfd 500 W Volt DC Disc Capacitr	2 EA	
22.	776.3410.0350	.1 Mfd 50Vdc Cap W/Rad Leads	2 EA	C9,C10
23.	776.3422.0350	.22 Mfd 50 Vdc Cpctr W/Rad Leads	1 EA	C8
24.	776.3447.0350	.47 MFD 50 VDC Capacitor, Rad Leads	2 EA	C4,C5
25.	781.3205.6006	600 PIV 2.0 Amp FW Bridge Rectifier	1 EA	D20
26.	782.1040.05	1N4005 1A 600V Silicon Rectifier	19 EA	D1-D8,D10-D19,D21

. . . continued on next page

TABLE 5-31 Parts List for 6284.234.01
MXR-350 Universal TOLA Assembly

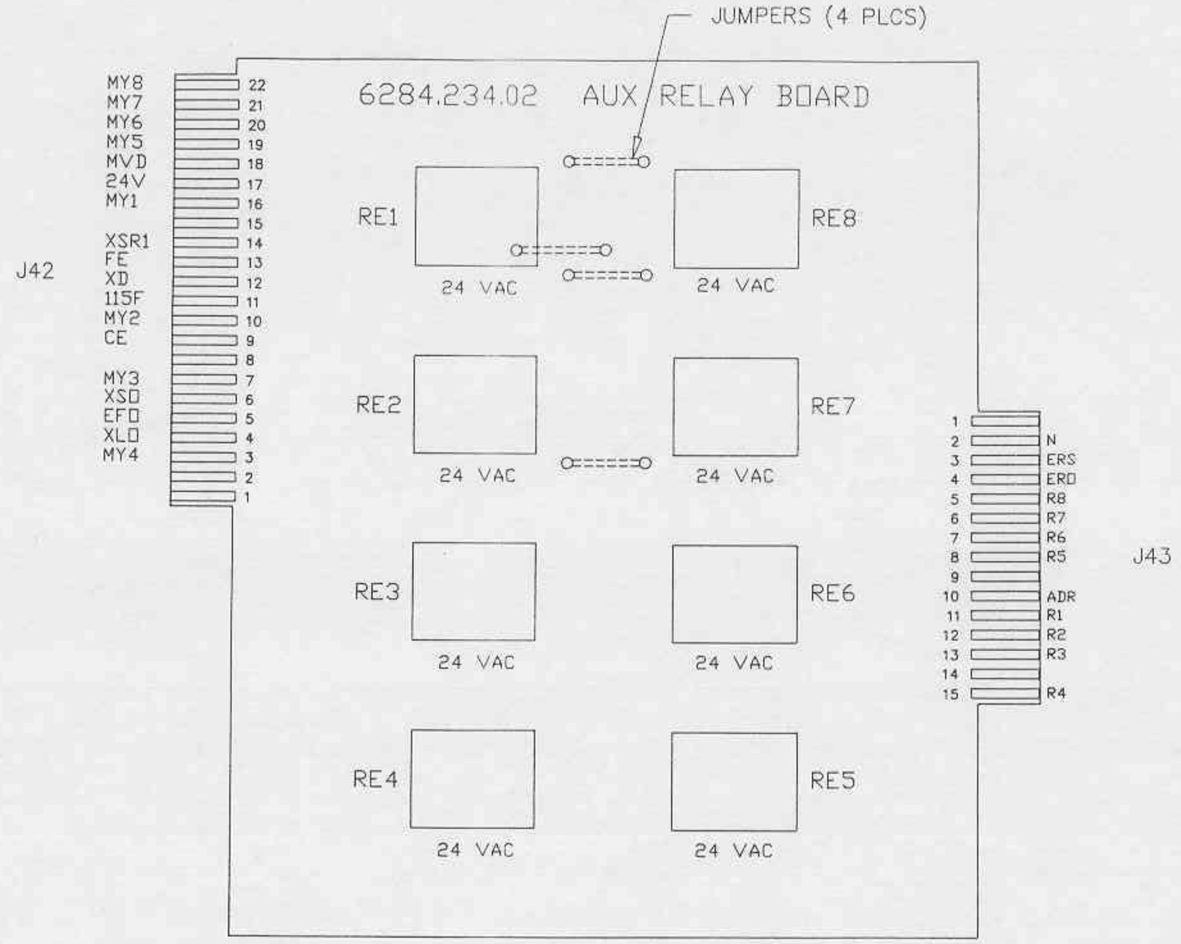
	Part Number	Description	Quantity	Reference Designators
27.	782.2034.16	2N3416 Transistor NPN	1 EA	Q1
28.	786.1223.3240	324 Quad OP Amp 14 DIP Ceramic	1 EA	U1
29.	786.2108.8122	7812 1A 12V Pos Voltage Regulator	1 EA	VR1
30.	786.2108.9122	7912 1.5A 12V Neg Regultr Ind/Plstc	1 EA	VR2
31.	787.1106.0370	Red/Green T1-3/4 LED (ac)	1 EA	LED1

TABLE 5-31 Parts List for 6284.234.01
MXR-350 Universal TOLA Assembly


J45-9 MY1
J45-8 MY2
J45-7 MY3
J45-6 MY4
J45-5 MY5
J45-3 MY6
J45-2 MY7
J45-1 MY8
J45-18 MVD +12 V
J44-6 N/U 0V IN GO
J44-11 ERR 115VAC IN GO
J44-13 115V
J44-15 N
T1
HS = 0V IN PREP
ERR = HS
D1
D2
D3
D4
D5
D6
D7
D8
D11
D12
D13
D14
D15
D16
D17
D18
1N4005 (16)
P1 50K
P2 20K
P3 20K
P4 50K
P5 20K
P6 20K
P7 50K
P8 50K
HIGH KVP SET
J45-13 KWH
200L SPOT
10K R14
25S
50S
100S
100L
150L
200L
300L
LONG TIME SET
J45-14 KWL
LONG TIME SET
J45-16 TOL
P11 20K
P12 20K
P13 20K
P14 20K
P15 20K
P16 20K
P17 20K
P18 20K
R4 27K
R16 27K
LED1
KW Overload Indicator
D20
C1 220/25
C2 220/25
VR1 7812
VR2 7912
D21 1N4005
SPDT 24V RE1
C4 .47/25
C5 .47/25
+12 V
0 V
TP0
-12 V
Q1 2N3416
+12V IN GO
-12V IN NO-GO
TP1
D19 1N4005
R12 4.7K
R13 1K
R15 2.7K
R8 2.2Meg
+12V IF KVP LESS THAN LIMIT
-12V IF NOT
U1 LM324
P10 10k MAX KVP LIMIT
R7 10k
TP3
R10 2.2Meg
TP2
+12V IN GO
-12V IN NO-GO
TP4
R11 10K
R9 10K
U1 LM324
C10 .1/25
D10 1N4005
J44-4 MRY
R1 100
C3 20/50
P9 20K
KVP RANGE ADJ 4.5V
J45-11 MV
R2 100K
R3 100K
J45-17 MVH
R5 680K
R6 680K
C6 .05/50
C7 .05/50
J44-5 MV
C8 .22/25
C9 .1/25
OUTPUT LINEAR WITH KVP

MXR-350 UNIVERSAL TOLA ASSEMBLY
FIGURE 5-54 SCHEMATIC FOR 6284.234.01

FIGURE 5-54
UNIVERSAL TOLA SCHEMATIC

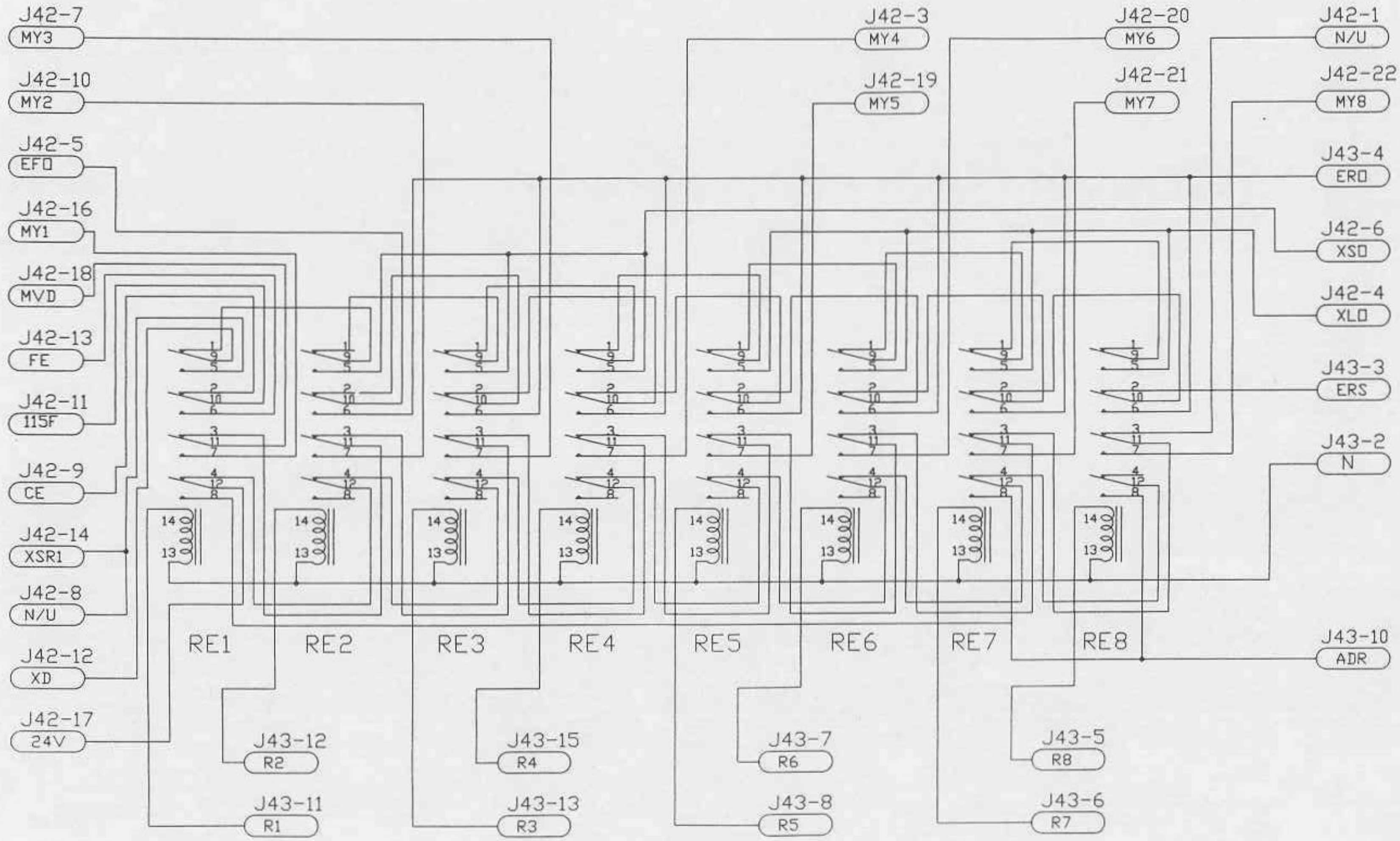

JUMPERS (4 PLCS)
6284.234.02 AUX RELAY BOARD
J42
MY8 22
MY7 21
MY6 20
MY5 19
MVD 18
24V 17
MY1 16
15
XSR1 14
FE 13
XD 12
115F 11
MY2 10
CE 9
8
MY3 7
XSD 6
EFD 5
XLD 4
MY4 3
2
1
RE1
RE2
RE3
RE4
RE5
RE6
RE7
RE8
24 VAC
J43
1
2 N
3 ERS
4 ERD
5 R8
6 R7
7 R6
8 R5
9
10 ADR
11 R1
12 R2
13 R3
14
15 R4

MXR-350 AUXILIARY RELAY PANEL ASSEMBLY

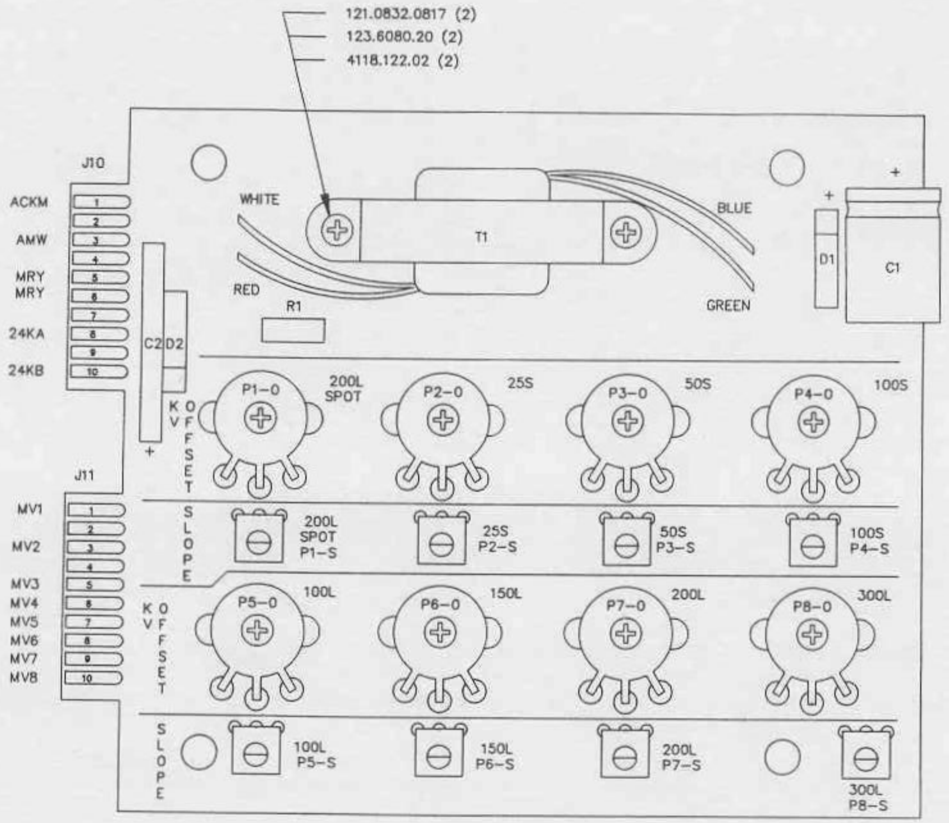
FIGURE 5-55 LAYOUT FOR 6284.234.02

	Part Number	Description	Quantity	Reference Designators
1.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
2.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
3.	4284.234.02	MXR-350 Auxilary Relay Panel Blank	1 EA	
4.	714.4355.1211	4PDT 24 Volt AC Mini Power Relay	8 EA	K1-K8
5.	714.9001.	4PDT Mini Relay Pc Socket	8 EA	
6.	714.9002.	Relay Hold-Down Spring	8 EA	
7.	738.0320.	20 Awg Solid Tinned Copper Wire	.40 FT	

TABLE 5-32 Parts List for 6284.234.02
MXR-350 Auxilary Relay Panel Asm


J42-7
MY3
J42-10
MY2
J42-5
EFD
J42-16
MY1
J42-18
MVD
J42-13
FE
J42-11
115F
J42-9
CE
J42-14
XSR1
J42-8
N/U
J42-12
XD
J42-17
24V
J42-3
MY4
J42-19
MY5
J42-20
MY6
J42-21
MY7
J42-1
N/U
J42-22
MY8
J43-4
ERD
J42-6
XSD
J42-4
XLD
J43-3
ERS
J43-2
N
J43-10
ADR
RE1
RE2
RE3
RE4
RE5
RE6
RE7
RE8
1
9
5
2
10
6
3
11
7
4
12
8
14
13
J43-12
R2
J43-11
R1
J43-15
R4
J43-13
R3
J43-7
R6
J43-8
R5
J43-5
R8
J43-6
R7

MXR-350 AUXILIARY RELAY PANEL ASSEMBLY
FIGURE 5-56 SCHEMATIC FOR 6284.234.02

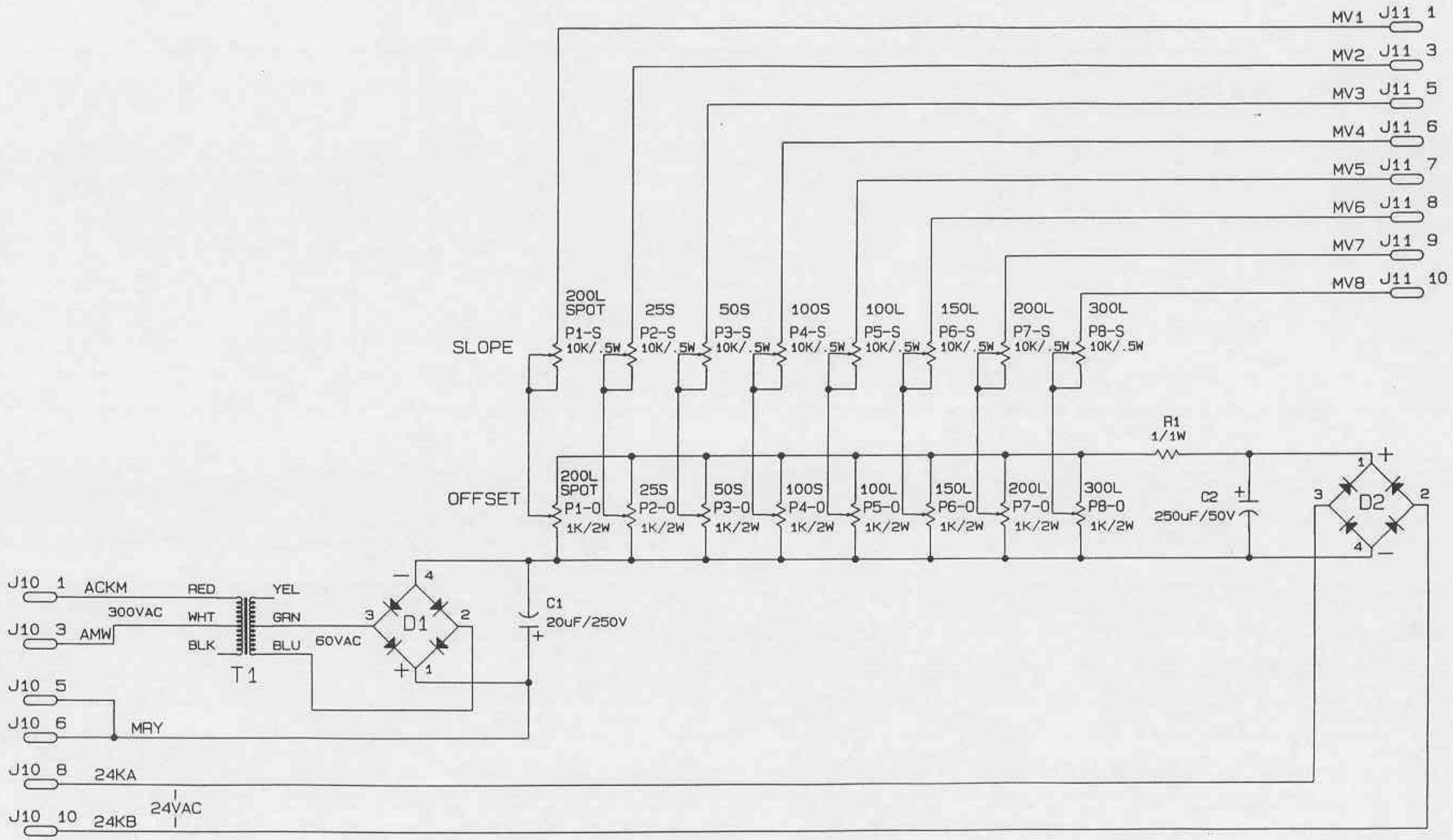

121.0832.0817 (2)
123.6080.20 (2)
4118.122.02 (2)
J10
ACKM
AMW
MRY
MRY
24KA
24KB
1
2
3
4
5
6
7
8
9
10
WHITE
RED
R1
T1
BLUE
GREEN
D1
C1
+
+
C2
D2
+
KV OFFSET
SLOPE
J11
MV1
MV2
MV3
MV4
MV5
MV6
MV7
MV8
P1–0
200L SPOT
P2–0
25S
P3–0
50S
P4–0
100S
200L SPOT P1–S
25S P2–S
50S P3–S
100S P4–S
KV OFFSET
P5–0
100L
P6–0
150L
P7–0
200L
P8–0
300L
SLOPE
100L P5–S
150L P6–S
200L P7–S
300L P8–S

MXR-350 kVp COMPENSATION PANEL ASM

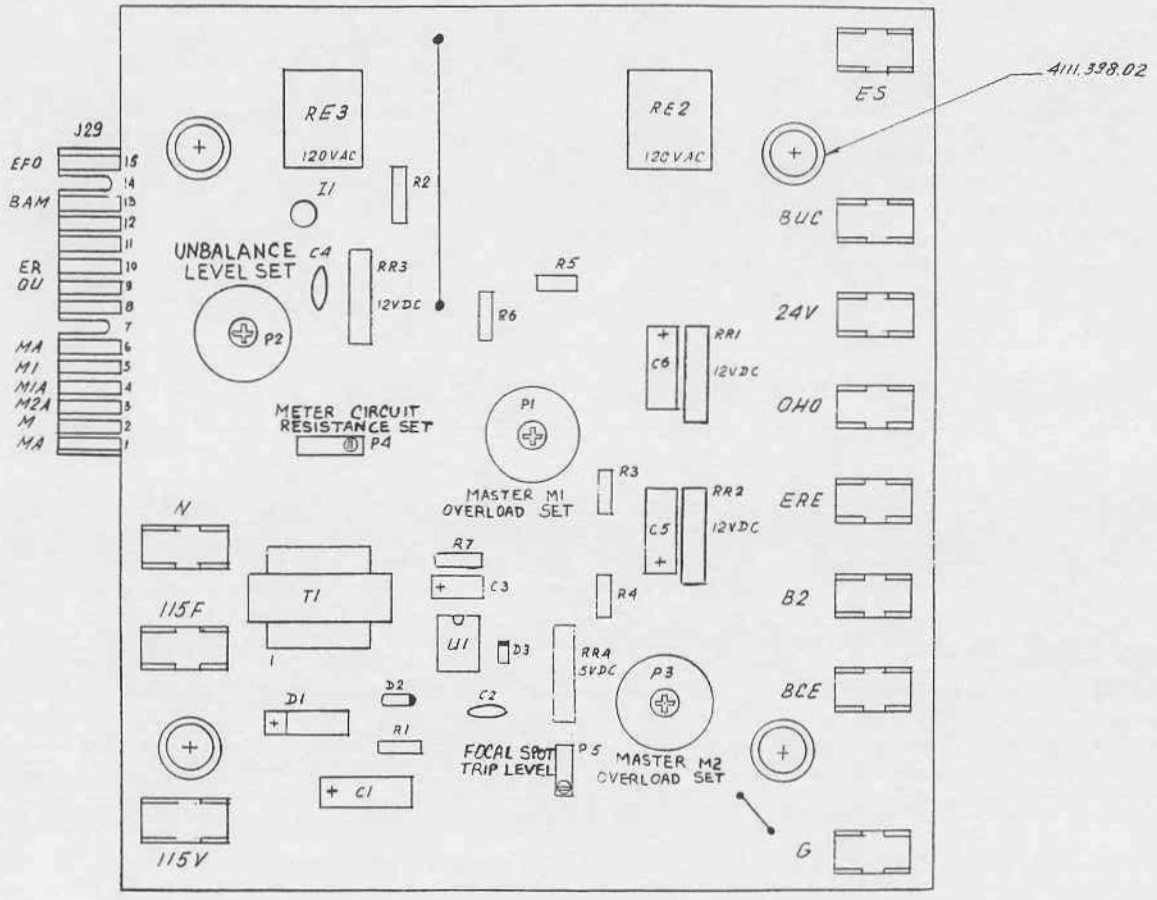
FIGURE 5-57 LAYOUT FOR 6284.234.03

	Part Number	Description	Quantity	Reference Designators
1.	121.0832.0817	8-32 X 1/2 Round Steel Philps Screw	2 EA	
2.	123.6080.20	#8 Internal Tooth Steel Lockwasher	2 EA	
3.	135.3300.8002	1/8" Black I/P Heat Shrink Tubing	.20 FT	
4.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
5.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
6.	4118.122.02	8-32 X 7/16 Fh A Rivnut	2 EA	
7.	4186.410.09	600 Volt Kvp Meter Transformer	1 EA	T1
8.	4284.234.03	MXR-350 kVp Comp Panel PC Blank	1 EA	
9.	751.2106.21	1R I Watt 5% Carbon Resistor	1 EA	R1
10.	754.1506.1009	1/2 Watt 10K Sub Min Potentiometer	8 EA	P1-S,P2-S,P3-S,P4-S, P5-S,P6-S,P7-S,P8-S
11.	755.2205.1001	1K 2 Watt WW Low T/C Potentiometer	8 EA	P1-0,P2-0,P3-0,P4-0, P5-0,P6-0,P7-0,P8-0
12.	771.1620.1425	20 Mfd 250 Volt Electyc Capacitor	1 EA	C1
13.	771.1725.1350	250 Mfd 50 Volt Elctyc Capacitor	1 EA	C2
14.	781.3205.6006	600 PIV 2.0 Amp FW Bridge Rectifier	2 EA	D1,2

TABLE 5-33 Parts List for 6284.234.03
MXR-350 kVp Compensation Panel Asm


MV1 J11 1
MV2 J11 3
MV3 J11 5
MV4 J11 6
MV5 J11 7
MV6 J11 8
MV7 J11 9
MV8 J11 10
SLOPE
200L SPOT P1-S 10K/.5W
25S P2-S 10K/.5W
50S P3-S 10K/.5W
100S P4-S 10K/.5W
100L P5-S 10K/.5W
150L P6-S 10K/.5W
200L P7-S 10K/.5W
300L P8-S 10K/.5W
OFFSET
200L SPOT P1-0 1K/2W
25S P2-0 1K/2W
50S P3-0 1K/2W
100S P4-0 1K/2W
100L P5-0 1K/2W
150L P6-0 1K/2W
200L P7-0 1K/2W
300L P8-0 1K/2W
R1 1/1W
C2 250uF/50V
D2
J10 1 ACKM
J10 3 AMW
300VAC
RED
WHT
BLK
T1
YEL
GRN
BLU
60VAC
D1
C1 20uF/250V
J10 5
J10 6 MRY
J10 8 24KA
J10 10 24KB
24VAC

MXR-350 kVp COMPENSATION PANEL ASM
FIGURE 5-58 SCHEMATIC FOR 6284.234.03


4111.398.02
J29
EFO
BAM
ER
OU
MA
M1
M1A
M2A
M
MA
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
RE3
120VAC
RE2
120VAC
ES
I1
R2
UNBALANCE
LEVEL SET
C4
RR3
12VDC
R5
R6
P2
BUC
24V
RR1
12VDC
C6
OHO
METER CIRCUIT
RESISTANCE SET
P4
P1
MASTER M1
OVERLOAD SET
R3
RR2
12VDC
C5
ERE
N
R7
C3
T1
115F
U1
D3
R4
B2
RRA
5VDC
P3
BCE
D2
C2
D1
R1
FOCAL SPOT
TRIP LEVEL
P5
MASTER M2
OVERLOAD SET
C1
G
115V

MXR-350 EXPOSURE INTERLOCK PNL ASM

FIGURE 5-59 LAYOUT FOR 6284.234.04

TOLERANCES-UNLESS OTHERWISE SPECIFIED: LENGTH-DECIMALS : .010" -FRACTIONS : 1/32" DIAMETERS-DECIMALS : .002" -FRACTIONS : .005" DIETZGEN NO. 199M AGEPROOF NO. 214.12

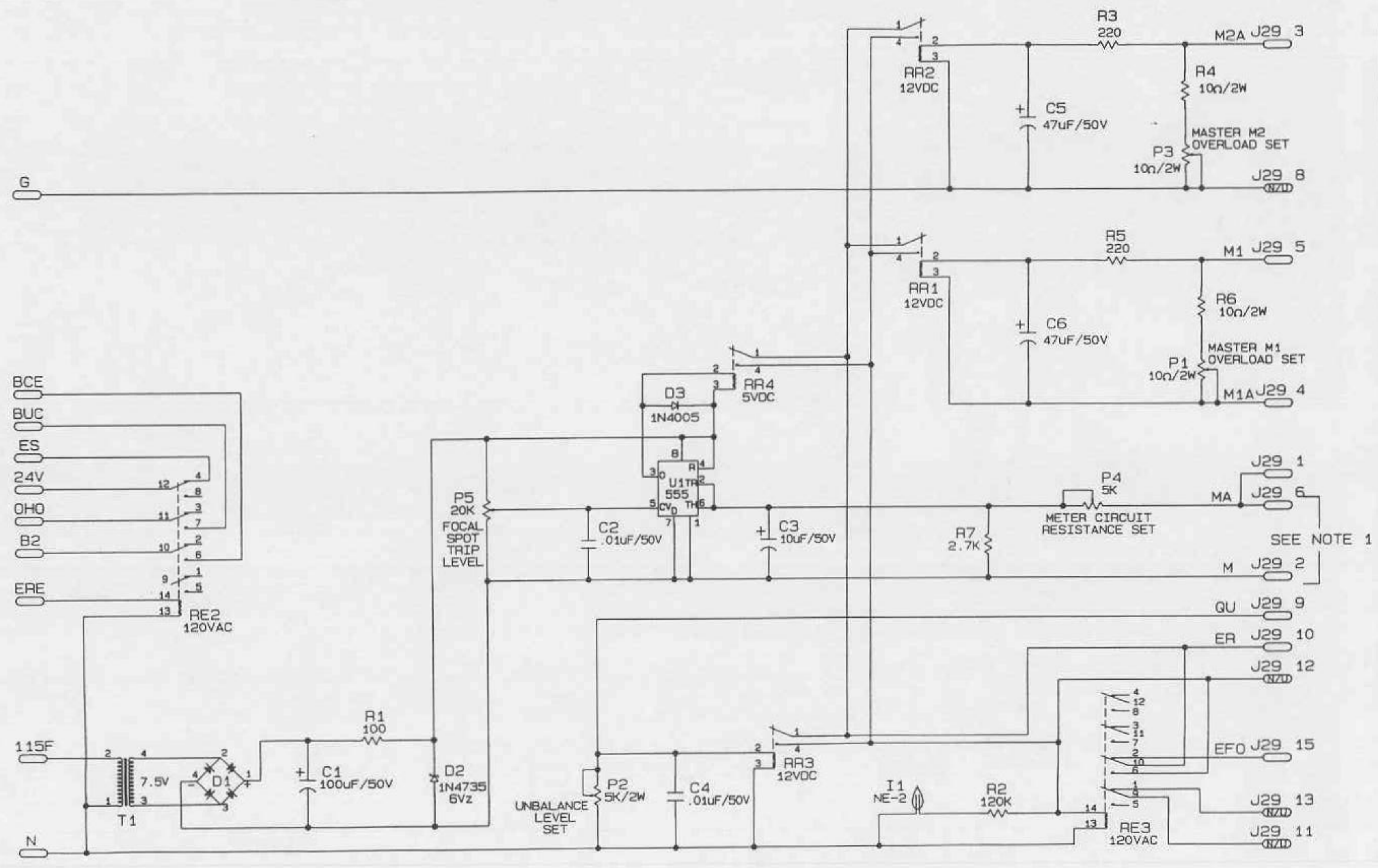
	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	22 EA	
2.	135.3416.01	#16 Teflon Insulating Tubing	.25 FT	
3.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
4.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
5.	4180.391.07	12 Volt DC Reed Relay SPST	3 EA	RR1-3
6.	4180.391.08	5 Volt DC 10 VA SPST Dry Reed Relay	1 EA	RR4
7.	4182.132.12	4-Way Tab Terminal	11 EA	
8.	4186.113.01	115V Pri Two 7.5V Sec Pwr Trnsfmr	1 EA	T1
9.	4189.222.03	Ne-2 Neon Glow Lamp	1 EA	I1
10.	4284.234.04	MXR-350 Exposure Interlock PC Blank	1 EA	
11.	714.4371.1221	4PDT 120 Volt AC Mini Relay	2 EA	RE2,RE3
12.	714.9001.	4PDT Mini Relay Pc Socket	2 EA	
13.	714.9002.	Relay Hold-Down Spring	2 EA	
14.	738.0320.	20 Awg Solid Tinned Copper Wire	.30 FT	
15.	751.1506.41	100R 1/2 Watt 5% Carbon Resistor	1 EA	R1
16.	751.1506.4220	220R 1/2 Watt 5% Carbon Resistor	2 EA	R3,5
17.	751.1506.5270	2.7K 1/2 Watt 5% Carbon Resistor	1 EA	R7
18.	751.1506.7120	120K 1/2 Watt 5% Carbon Resistor	1 EA	R2
19.	752.2206.31	10R 2W 5% Fixed WW Low T/C Resistor	2 EA	R4,6
20.	754.1505.5011	5K .5W 20 Turn 3/8 Sq Vert Adj Pot	1 EA	P4
21.	754.1506.2011	1/2W 20K 20T Vert Adj 3/8 Sq Potmtr	1 EA	P5
22.	755.2203.1001	10R 2 Watt WW Low T/C Potentiometer	2 EA	P1,P3
23.	755.2205.5001	5K 2 Watt WW Low T/C Potentiometer	1 EA	P2
24.	771.1610.1350	10 Mfd 50 Volt Electroltc Capacitor	1 EA	C3
25.	771.1650.1350	50 Mfd 50 Volt DC Elctyc Capacitor	2 EA	C5,6
26.	771.1710.0325	100 Mfd 25 V Electrlytc Capacitor	1 EA	C1

. . . continued on next page

TABLE 5-34 Parts List for 6284.234.04
MXR-350 Exposure Interlock Pnl Asm

	Part Number	Description	Quantity	Reference Designators
27.	776.1310.0350	.01 MFD 50V Ceramic Disc Capacitor	2 EA	C2,4
28.	781.3205.6006	600 PIV 2.0 Amp FW Bridge Rectifier	1 EA	D1
29.	782.1040.05	1N4005 1A 600V Silicon Rectifier	1 EA	D3
30.	782.1047.35	1N4735 6.2 Volt Zener Diode	1 EA	D2
31.	786.1222.5551	555 Timer Ceramic High-Temp	1 EA	U1

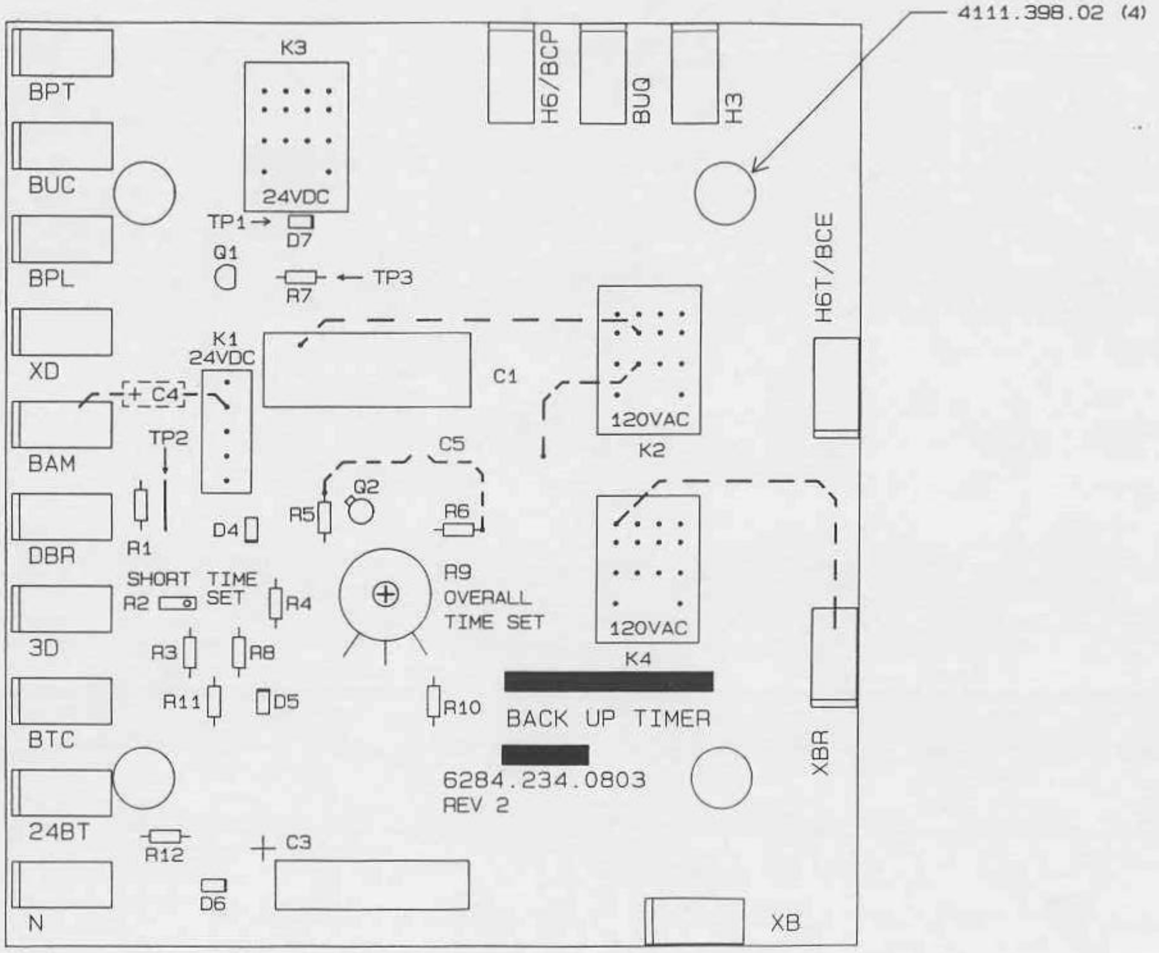
TABLE 5-34 Parts List for 6284.234.04
MXR-350 Exposure Interlock Pnl Asm


G
BCE
BUC
ES
24V
OHO
B2
ERE
115F
N
RE2
120VAC
T1
7.5V
D1
C1
100uF/50V
R1
100
D2
1N4735
6Vz
P5
20K
FOCAL
SPOT
TRIP
LEVEL
D3
1N4005
U1
555
C2
.01uF/50V
RR4
5VDC
C3
10uF/50V
UNBALANCE
LEVEL
SET
P2
5K/2W
C4
.01uF/50V
RR3
12VDC
I1
NE-2
R2
120K
RE3
120VAC
R7
2.7K
P4
5K
METER CIRCUIT
RESISTANCE SET
RR2
12VDC
C5
47uF/50V
R3
220
R4
10Ω/2W
P3
10Ω/2W
MASTER M2
OVERLOAD SET
RR1
12VDC
C6
47uF/50V
R5
220
R6
10Ω/2W
P1
10Ω/2W
MASTER M1
OVERLOAD SET
M2A J29 3
J29 8
M1 J29 5
M1A J29 4
J29 1
MA J29 6
SEE NOTE 1
M J29 2
QU J29 9
ER J29 10
J29 12
EFO J29 15
J29 13
J29 11
N/O

MXR-350 EXPOSURE INTERLOCK PNL ASM

FIGURE 5-60 SCHEMATIC FOR 6284.234.04

Page 5-107


4111.398.02 (4)
K3
24VDC
BPT
BUC
BPL
XD
BAM
DBR
3D
BTC
24BT
N
TP1
D7
Q1
R7
TP3
K1
24VDC
+ C4
TP2
R1
D4
C1
C5
Q2
R5
R6
SHORT TIME SET
R2
R4
R3
R8
R11
D5
R9
OVERALL
TIME SET
R10
H6/BCP
BUQ
H3
H6T/BCE
120VAC
K2
120VAC
K4
BACK UP TIMER
6284.234.0803
REV 2
XBR
R12
C3
D6
XB

MXR-350 BACKUP TIMER PANEL ASM

FIGURE 5-61 LAYOUT FOR 6284.234.0803

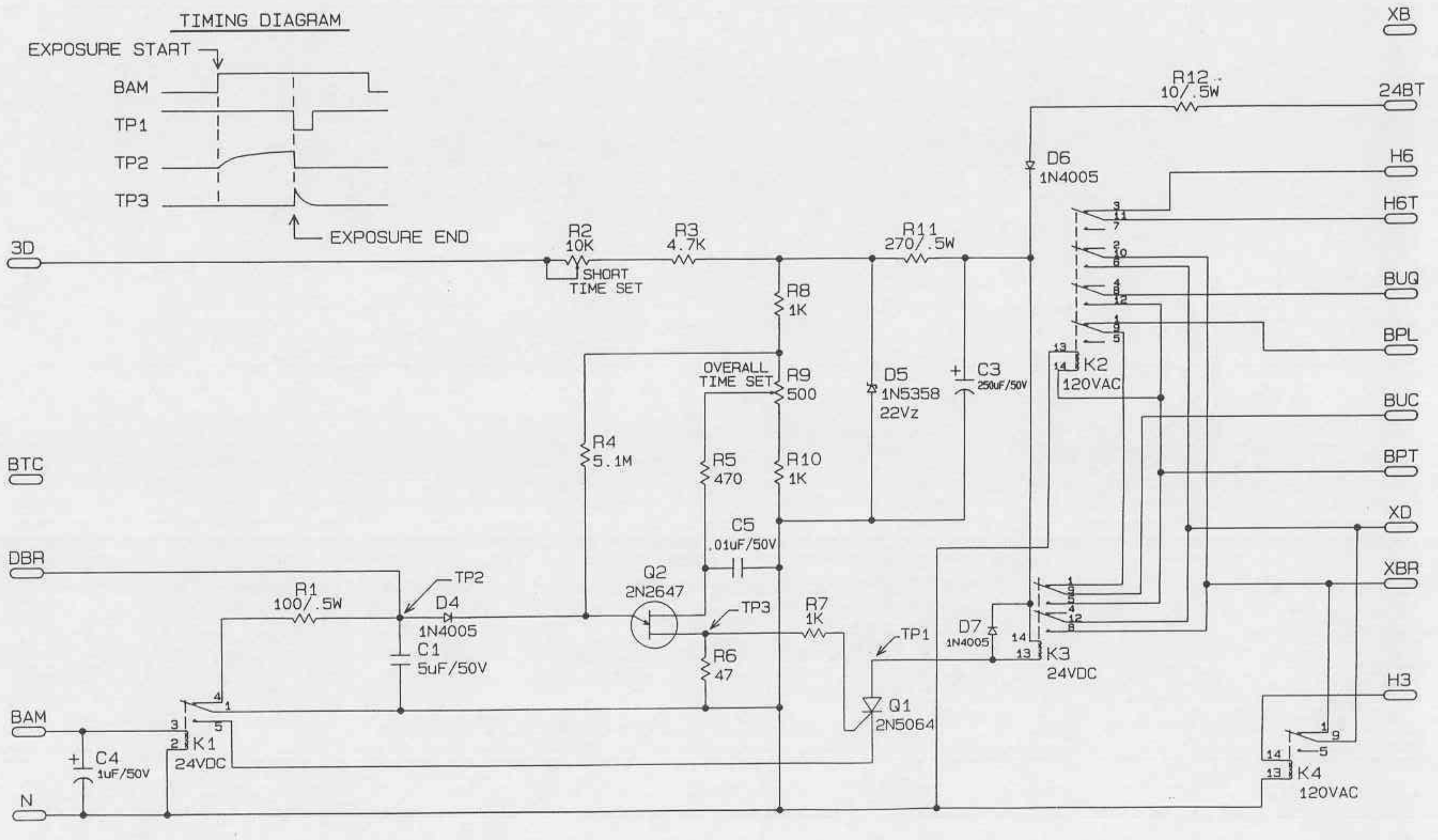
	Part Number	Description	Quantity	Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	32 EA	
2.	135.3416.01	#16 Teflon Insulating Tubing	.20 FT	
3.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
4.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
5.	4180.503.20	24 Volt DC Reed Relay SPDT	1 EA	K1
6.	4182.132.12	4-Way Tab Terminal	16 EA	
7.	4284.234.0803	MXR-350 Backup Timer Panel PC Blank	1 EA	
8.	714.4371.1221	4PDT 120 Volt AC Mini Relay	2 EA	K2,4
9.	714.4665.1222	4PDT 24 Volt DC Mini Power Relay	1 EA	K3
10.	714.9001.	4PDT Mini Relay Pc Socket	3 EA	
11.	714.9002.	Relay Hold-Down Spring	3 EA	
12.	733.2207.0111	22 Ga 1 Con 300v Brown Hookup Wire	.80 FT	
13.	738.0320.	20 Awg Solid Tinned Copper Wire	.20 FT	
14.	751.1256.3470	47 Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R6
15.	751.1256.4470	470 Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R5
16.	751.1256.51	1.0K 1/4 Watt 5% Carbon Resistor	3 EA	R7,8,10
17.	751.1256.5470	4.7K 1/4 Watt 5% Carbon Resistor	1 EA	R3
18.	751.1506.31	10R 1/2 Watt 5% Carbon Resistor	1 EA	R12
19.	751.1506.41	100R 1/2 Watt 5% Carbon Resistor	1 EA	R1
20.	751.1506.4270	270R 1/2 Watt 5% Carbon Resistor	1 EA	R11
21.	751.1506.8510	5.1M 1/2 Watt 5% Carbon Resistor	1 EA	R4
22.	754.1506.1011	1/2W 10K 20T Vert Adj 3/8 Sq Potmtr	1 EA	R2
23.	755.2204.5001	500R 2 Watt WW Low T/C Potentiometr	1 EA	R9
24.	771.1510.2350	1 Mfd 50 Volt Electyc Capacitor	1 EA	C4
25.	771.1725.1350	250 Mfd 50 Volt Elctyc Capacitor	1 EA	C3
26.	773.6550.2350	5 Mfd 50 Volt #6 Mylar Capacitor	1 EA	C1

. . . continued on next page

TABLE 5-35 Parts List for 6284.234.0803
MXR-350 Backup Timer Panel Asm

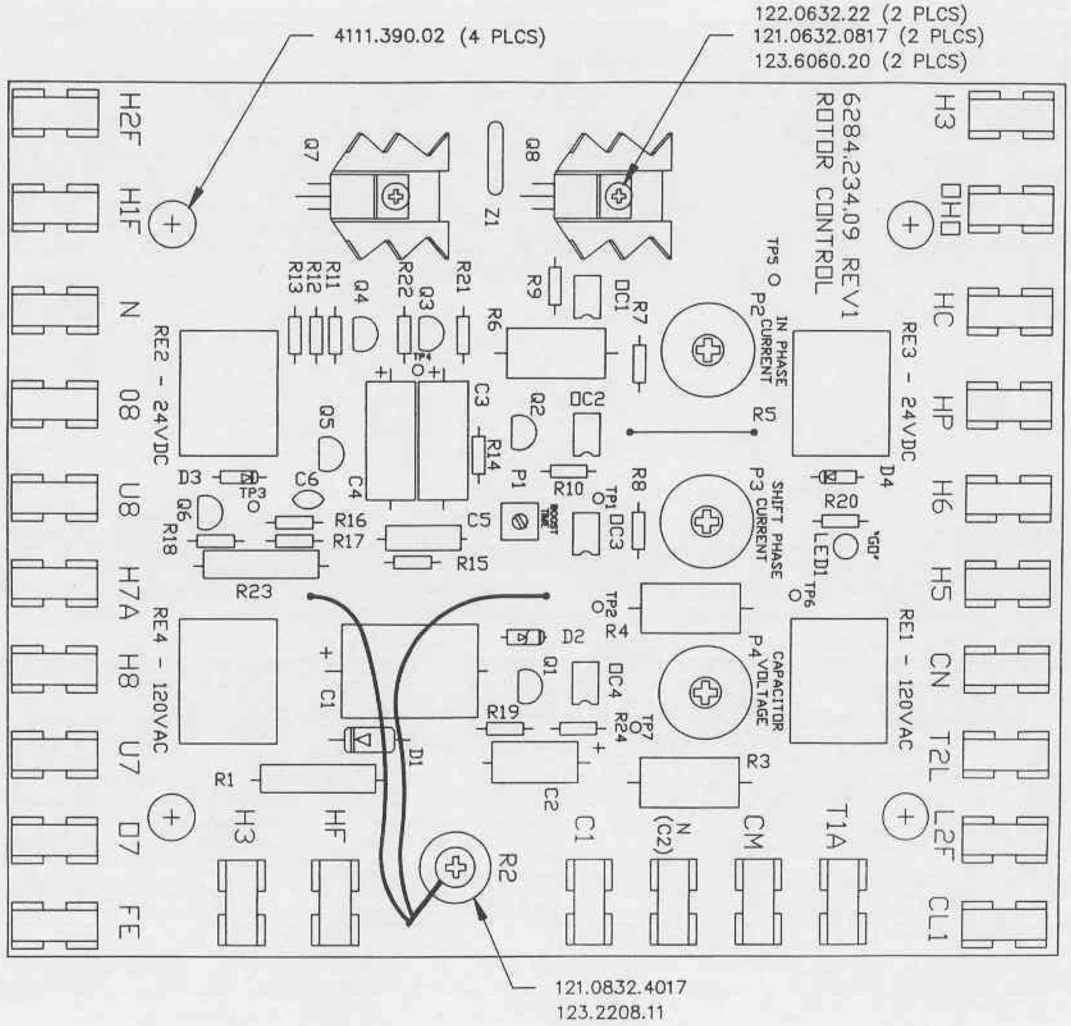
	Part Number	Description	Quantity	Reference Designators
27.	776.1310.0350	.01 MFD 50V Ceramic Disc Capacitor	1 EA	C5
28.	782.1040.05	1N4005 1A 600V Silicon Rectifier	3 EA	D4,6,7
29.	782.1053.58	1N5358 22V 5W 10% Zener Diode	1 EA	D5
30.	782.2026.47	GE-2N2647 UJ Transistor	1 EA	Q2
31.	782.2050.64	2N5064 SCR 0.8A 200 Volt	1 EA	Q1

TABLE 5-35 Parts List for 6284.234.0803
MXR-350 Backup Timer Panel Asm


TIMING DIAGRAM
EXPOSURE START
BAM
TP1
TP2
TP3
EXPOSURE END
3D
BTC
DBR
BAM
N
R2
10K
SHORT
TIME SET
R3
4.7K
R8
1K
OVERALL
TIME SET
R9
500
R10
1K
R4
5.1M
R5
470
C5
.01uF/50V
R11
270/.5W
D5
1N5358
22Vz
C3
250uF/50V
R12
10/.5W
D6
1N4005
K2
120VAC
R1
100/.5W
TP2
D4
1N4005
C1
5uF/50V
Q2
2N2647
TP3
R6
47
R7
1K
TP1
Q1
2N5064
D7
1N4005
K3
24VDC
K1
24VDC
C4
1uF/50V
K4
120VAC
XB
24BT
H6
H6T
BUQ
BPL
BUC
BPT
XD
XBR
H3

MXR-350 BACKUP TIMER PANEL ASM

FIGURE 5-62 SCHEMATIC FOR 6284.234.0803


4111.390.02 (4 PLCS)
122.0632.22 (2 PLCS)
121.0632.0817 (2 PLCS)
123.6060.20 (2 PLCS)
121.0832.4017
123.2208.11
6284.234.09 REV1
ROTOR CONTROL
H2F
H1F
N
08
U8
H7A
H8
U7
D7
FE
H3
DHD
HC
HP
H6
H5
CN
T2L
L2F
CL1
RE2 - 24VDC
RE4 - 120VAC
RE3 - 24VDC
RE1 - 120VAC
Q7
Q8
Z1
R13
R12
R11
Q4
R22
Q3
TP4
R21
R9
DC1
R7
TP5
P2 CURRENT
IN PHASE
R6
C3
C4
Q5
Q2
DC2
R5
R14
D3
TP3
C6
Q6
R18
R16
R17
C5
P1
BOOST TIME
R10
TP1
DC3
R8
P3 CURRENT
SHIFT PHASE
D4
R20
LED1
"GD"
TP6
R15
R23
TP2
R4
D2
Q1
DC4
C1
R19
R24
TP7
P4 VOLTAGE
CAPACITOR
D1
R1
C2
R3
H3
HF
C1
N (C2)
CM
T1A
R2

MXR-350 ROTOR CONTROL WITH PHOTOTRANSISTORS

FIGURE 5-63 LAYOUT FOR 6284.234.09

	Part Number	Description	Quantity	Reference Designators
1.	121.0632.0817	6-32 X 1/2 Round Steel Philps Screw	2 EA	
2.	121.0832.4017	8-32 X 2-1/2 Round Steel Phlp Screw	1 EA	
3.	122.0632.22	6-32 Double Chamfered Hex Steel Nut	2 EA	
4.	123.2208.11	.171 ID .500 OD .070Thk.Brass Wash.	1 EA	
5.	123.6060.20	#6 Internal Tooth Steel Lockwasher	2 EA	
6.	129.5120.6511	1/8 X 3/16 Brass Eyelet	52 EA	
7.	135.3416.01	#16 Teflon Insulating Tubing	.50 FT	
8.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
9.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
10.	4118.122.02	8-32 X 7/16 Fh A Rivnut	1 EA	
11.	4144.443.05	Series291 Scrw Mt Alum Trnstr Htsnk	2 EA	
12.	4182.132.12	4-Way Tab Terminal	26 EA	
13.	4189.205.01	230VAC 35 Joule Varistor	1 EA	Z1
14.	4189.232.10	Green Led Solid State Lamp	1 EA	LED1
15.	4284.234.09	Rotor Control W/Phototrns Blnk -Mil	1 EA	
16.	714.4371.1221	4PDT 120 Volt AC Mini Relay	2 EA	RE1,RE4
17.	714.4665.1222	4PDT 24 Volt DC Mini Power Relay	2 EA	RE2,RE3
18.	714.9001.	4PDT Mini Relay Pc Socket	4 EA	
19.	714.9002.	Relay Hold-Down Spring	4 EA	
20.	738.0320.	20 Awg Solid Tinned Copper Wire	.60 FT	
21.	751.1506.41	100R 1/2 Watt 5% Carbon Resistor	2 EA	R7,R8
22.	751.1506.51	1K 1/2 Watt 5% Carbon Resistor	4 EA	R11,R13,R18,R21
23.	751.1506.5220	2.2K 1/2 Watt 5% Carbon Resistor	3 EA	R16,R17,R22
24.	751.1506.5270	2.7K 1/2 Watt 5% Carbon Resistor	1 EA	R20
25.	751.1506.61	10K 1/2 Watt 5% Carbon Resistor	2 EA	R9,R19
26.	751.1506.6160	16K 1/2 Watt 5% Carbon Resistor	1 EA	R12

. . . continued on next page

TABLE 5-36 Parts List for 6284.234.09
MXR-350 Rotor Cntrl W/Phototransist

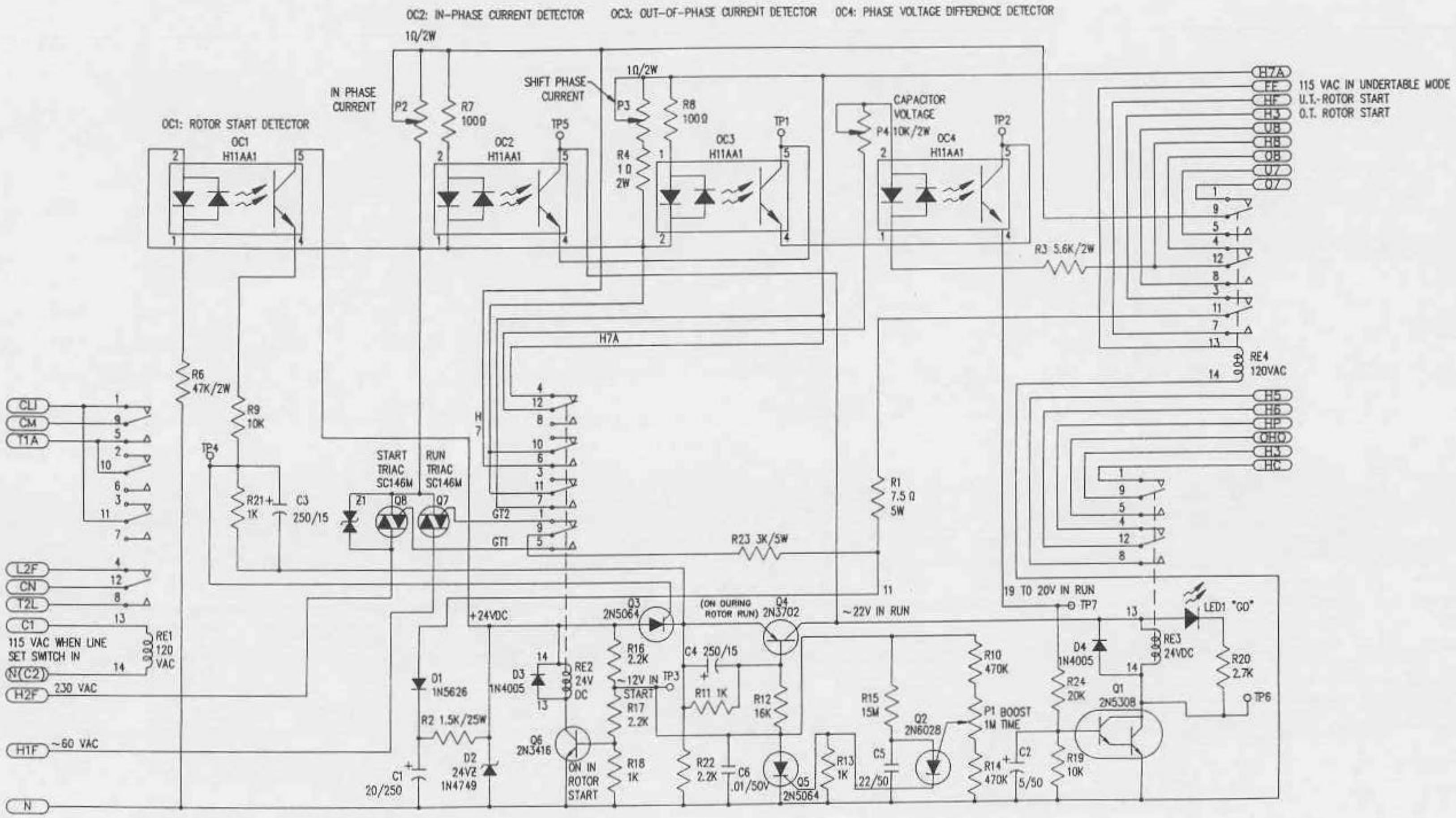
	Part Number	Description	Quantity	Reference Designators
27.	751.1506.62	20K 1/2 Watt 5% Carbon Resistor	1 EA	R24
28.	751.1506.7470	470K 1/2 Watt 5% Carbon Resistor	2 EA	R10,R14
29.	751.1506.9150	15M 1/2 Watt 5% Carbon Resistor	1 EA	R15
30.	751.2206.21	1 Ohm 2 Watt 5% Carbon Resistor	1 EA	R4
31.	751.2206.5560	5.6K 2 Watt 5% Carbon Resistor	1 EA	R3
32.	751.2206.6470	47K 2 Watt 5% Carbon Resistor	1 EA	R6
33.	752.2506.2750	7.5R 5W 5% Fxd WW Low T/C Resistor	1 EA	R1
34.	752.2506.53	3K 5W 5% Fixed WW Low T/C Resistor	1 EA	R23
35.	753.3251.5150	1.50K 25W WW Adj Low T/C Resistor	1 EA	R2
36.	754.1508.1010	1M Cermet Multi-Turn Potentiometer	1 EA	P1
37.	755.2202.1001	1R 2 Watt WW Low T/C Potentiometer	2 EA	P2,P3
38.	755.2206.1001	10K 2 Watt WW Low T/C Potentiometer	1 EA	P4
39.	764.1020.10	Cambion Type K 2085-02 PC Terminal	7 EA	TP1-TP7
40.	771.1550.2350	5 Mfd 50 Volt Elctlt Capacitor	1 EA	C2
41.	771.1620.1425	20 Mfd 250 Volt Electyc Capacitor	1 EA	C1
42.	771.1725.1315	250 Mfd 15 Volt Elctyc Capacitor	2 EA	C3,C4
43.	773.1422.3350	.22 Mfd 50 Volt #1 Mylar Capacitor	1 EA	
44.	776.1310.0350	.01 MFD 50V Ceramic Disc Capacitor	1 EA	C6
45.	782.1040.05	1N4005 1A 600V Silicon Rectifier	2 EA	D3,D4
46.	782.1047.49	1N4749 24V 1 Watt Zener Diode	1 EA	D2
47.	782.1056.26	1N5626 3Amp 600V Silicon Rectifier	1 EA	D1
48.	782.2034.16	2N3416 Transistor NPN	1 EA	Q6
49.	782.2037.02	2N3702 Transistor PNP	1 EA	Q4
50.	782.2050.64	2N5064 SCR 0.8A 200 Volt	2 EA	Q3,Q5
51.	782.2053.08	2N5308 Darlington Transistor	1 EA	Q1
52.	782.2060.28	2N6028 Prgrmbl Unjctn Transistor	1 EA	Q2

. . . continued on next page

TABLE 5-36 Parts List for 6284.234.09
MXR-350 Rotor Cntrl W/Phototransist

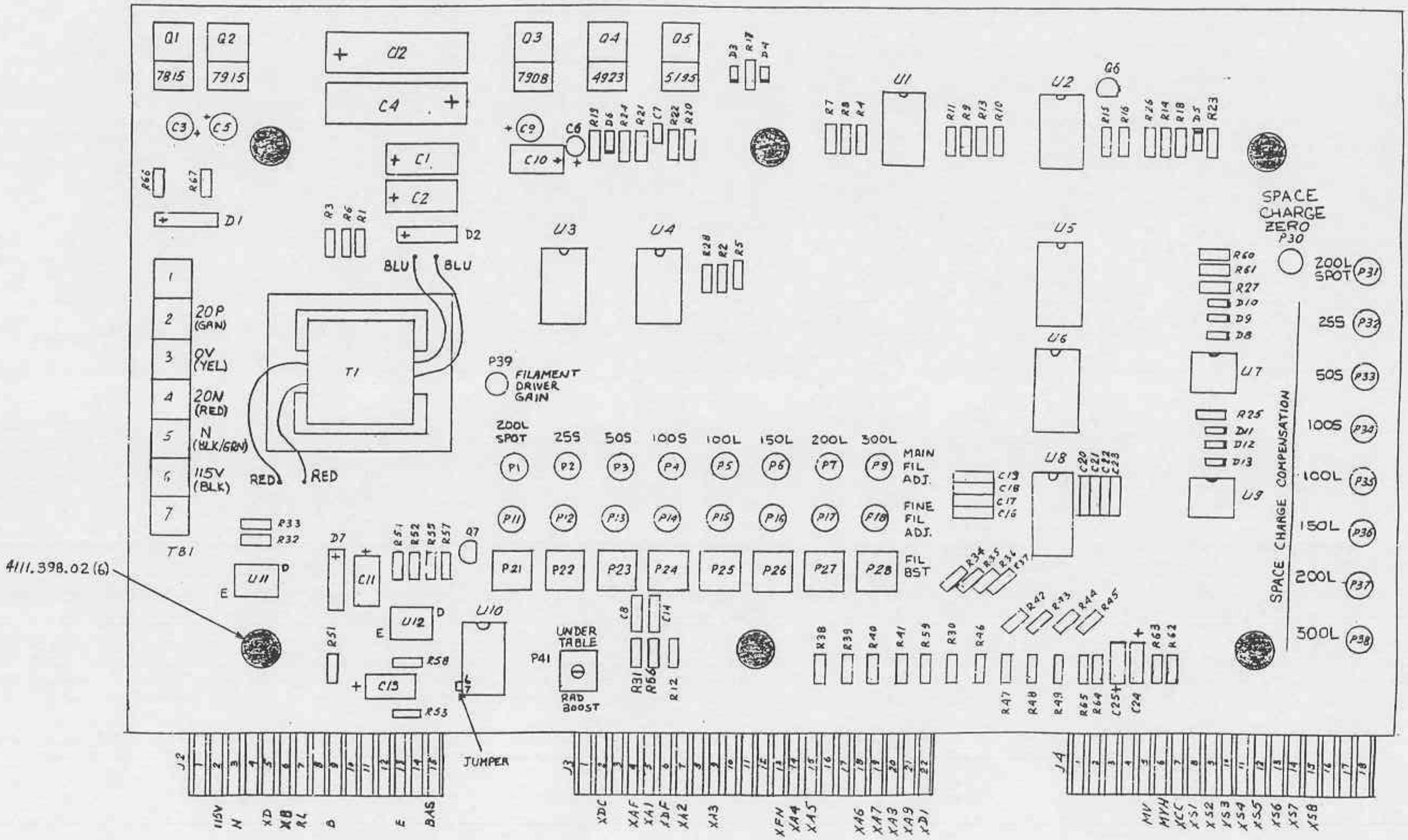
	Part Number	Description	Quantity	Reference Designators
53.	784.4105.6012	10 Amp 600 Volt Triac (SC146M)	2 EA	Q7,Q8
54.	786.9109.8011	H11AA1 AC Darlington Opto Coupler	4 EA	OC1-OC4

TABLE 5-36 Parts List for 6284.234.09
MXR-350 Rotor Cntrl W/Phototransist


OC1: ROTOR START DETECTOR
OC2: IN-PHASE CURRENT DETECTOR
OC3: OUT-OF-PHASE CURRENT DETECTOR
OC4: PHASE VOLTAGE DIFFERENCE DETECTOR
OC1 H11AA1
OC2 H11AA1
OC3 H11AA1
OC4 H11AA1
IN PHASE CURRENT
P2
1Ω/2W
R7 100Ω
SHIFT PHASE CURRENT
P3
R8 100Ω
R4 1Ω 2W
CAPACITOR VOLTAGE
P4 10K/2W
TP5
TP1
TP2
R3 5.6K/2W
H7A
FE
HF
H3
UB
HB
OB
U7
O7
115 VAC IN UNDERTABLE MODE
U.T.-ROTOR START
O.T. ROTOR START
RE4 120VAC
H5
H6
HP
OHO
H3
HC
R6 47K/2W
R9 10K
TP4
R21 1K
C3 250/15
Z1
START TRIAC SC146M
RUN TRIAC SC146M
Q8
Q7
GT2
GT1
H 7
R1 7.5 Ω 5W
R23 3K/5W
CLI
CM
T1A
L2F
CN
T2L
C1
115 VAC WHEN LINE SET SWITCH IN
N(C2)
H2F
230 VAC
H1F
~60 VAC
N
RE1 120 VAC
+24VDC
D1 1N5626
R2 1.5K/25W
C1 20/250
D2 24VZ 1N4749
D3 1N4005
RE2 24V DC
Q6 2N3416
ON IN ROTOR START
Q3 2N5064
R16 2.2K
~12V IN START
TP3
R17 2.2K
R18 1K
(ON DURING ROTOR RUN) Q4 2N3702
C4 250/15
R11 1K
R12 16K
R22 2.2K
C6 .01/50V
Q5 2N5064
R13 1K
~22V IN RUN
R15 15M
C5 22/50
Q2 2N6028
R10 470K
P1 BOOST 1M TIME
R14 470K
C2 5/50
19 TO 20V IN RUN
TP7
D4 1N4005
R24 20K
R19 10K
Q1 2N5308
RE3 24VDC
LED1 "GO"
R20 2.7K
TP6

MXR-350 ROTOR CONTROL WITH PHOTOTRANSISTORS

FIGURE 5-64 SCHEMATIC FOR 6284.234.09


Q1
7815
Q2
7915
C12
C4
Q3
7908
Q4
4923
Q5
5195
C3
C5
R66
R67
D1
C1
C2
D2
R3
R6
R1
C9
C6
C10
R19
D6
R24
R21
C7
R22
R20
D3
R17
D4
R7
R8
R4
U1
R11
R9
R13
R10
U2
G6
R15
R16
R26
R14
R18
D5
R23
SPACE CHARGE ZERO
P30
BLU
BLU
U3
U4
R28
R2
R5
U5
U6
R60
R61
R27
D10
D9
D8
200L SPOT
P31
25S
P32
50S
P33
100S
P34
100L
P35
150L
P36
200L
P37
300L
P38
SPACE CHARGE COMPENSATION
1
2
20P (GRN)
3
0V (YEL)
4
20N (RED)
5
N (BLK/GRN)
6
115V (BLK)
7
TB1
T1
RED
RED
P39
FILAMENT DRIVER GAIN
200L SPOT
25S
50S
100S
100L
150L
200L
300L
P1
P2
P3
P4
P5
P6
P7
P9
MAIN FIL ADJ.
P11
P12
P13
P14
P15
P16
P17
P18
FINE FIL ADJ.
P21
P22
P23
P24
P25
P26
P27
P28
FIL BST
C19
C18
C17
C16
U8
C20
C21
C22
C23
U7
R25
D11
D12
D13
U9
R33
R32
D7
R51
R52
R55
R57
Q7
C11
4111.398.02 (6)
U11
D
E
U12
D
E
U10
R51
R58
C15
R53
JUMPER
P41
UNDER TABLE
RAD BOOST
C8
C14
R31
R56
R12
R34
R35
R36
R37
R42
R43
R44
R45
R38
R39
R40
R41
R59
R30
R46
R47
R48
R49
R65
R64
C25
C24
R63
R62
J2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
115V
N
XD
XB
RL
B
E
BAS
J3
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
XDC
XAF
XA1
XDF
XA2
XA3
XFN
XA4
XA5
XA6
XA7
XA3
XA9
XD1
J4
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
MV
MYH
XCC
XS1
XS2
XS3
XS4
XS5
XS6
XS7
XS8

MXR-350 CONSTANT CURRENT FILAMENT CONTROL ASM

FIGURE 5-65 LAYOUT FOR 6284.234.1009

DIETZGEN NO. 198M AGEPROOF NO. 318.12

	Part Number	Description	Quantity	Reference Designators
1.	121.0540.1657	5-40 X 1 Pan Steel Phillips Screw	2 EA	
2.	122.0540.22	5-40 Double Chamfered Hex Steel Nut	2 EA	
3.	123.6060.20	#6 Internal Tooth Steel Lockwasher	2 EA	
4.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
5.	4111.398.02	Etched Panel Mounting Bushing (3/4)	6 EA	
6.	4155.222.05	1/4 OD X 3/16 L Switch Spacer	2 EA	
7.	4284.234.1009	MXR-350 Filament Crnt Cntrl PC Blnk	1 EA	
8.	5186.230.12	3P Filament Current Transformer	1 EA	T1
9.	751.1256.21	1 Ohm 1/4 Watt 5% Carbon Resistor	2 EA	R66,R67
10.	751.1256.51	1.0K 1/4 Watt 5% Carbon Resistor	2 EA	R17,R20
11.	751.1256.5220	2.2K 1/4 Watt 5% Carbon Resistor	2 EA	R32,R54
12.	751.1256.5330	3.3K 1/4 Watt 5% Carbon Resistor	3 EA	R1,R3,R60
13.	751.1256.5680	6.8K 1/4 Watt 5% Carbon Resistor	1 EA	R51
14.	751.1256.61	10K Ohm 1/4 Watt 5% Carbon Resistor	7 EA	R9,R13-R15,R18, R25,R27
15.	751.1256.6150	15K Ohm 1/4 Watt 5% Carbon Resistor	2 EA	R19,R24
16.	751.1256.6220	22K Ohm 1/4 Watt 5% Carbon Resistor	5 EA	R22,R52,R53,R57,R64
17.	751.1256.6330	33K Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R33
18.	751.1256.6470	47K Ohm 1/4 Watt 5% Carbon Resistor	10 EA	R4-R8,R10,R11,R12, R23,R63
19.	751.1256.6510	51K Ohm 1/4 Watt 5% Carbon Resistor	2 EA	R61,R62
20.	751.1256.6560	56K Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R65
21.	751.1256.71	100K Ohm 1/4 Watt 5% Carbon Resistr	20 EA	R30,R31,R34-49, R56,R59
22.	751.1256.7150	150K Ohm 1/4 Watt 5% Carbon Resistr	2 EA	R21,R55
23.	751.1256.7220	220K Ohm 1/4 Watt 5% Carbon Resistr	1 EA	R58
24.	751.1256.7270	270K Ohm 1/4 Watt 5% Carbon Resistr	1 EA	R28
25.	751.1256.7680	680K Ohm 1/4 Watt 5% Carbon Resistr	2 EA	R16,R26

. . . continued on next page

TABLE 5-37 Parts List for 6284.234.1009
MXR-350 Cnstnt Crnt Flmnt Cntrl Asm

	Part Number	Description	Quantity	Reference Designators
26.	751.1256.81	1.0M Ohm 1/4 Watt 5% Carbon Resistr	1 EA	R2
27.	754.1505.1010	1K Cermet Multi-Turn Potentiometer	9 EA	P11-P18,P30
28.	754.1505.1016	1K 1/2W 10-Turn Top Adj Cermet Pot	8 EA	P21-P28
29.	754.1506.1010	10K Cermet 4-Turn Potentiometer	8 EA	P1-P8
30.	754.1506.2002	1/2 Watt 20K Carbon Potentiometer	1 EA	P40
31.	754.1507.1009	1/2 Watt 100K Sub Min Potentiometer	1 EA	P39
32.	754.1508.1012	1M Cermet 4-Turn Pot, Top Adj	8 EA	P31-P38
33.	761.3202.1070	7 Point 3/16 Faston Pcp Term Strip	1 EA	TB1
34.	771.1550.2350	5 Mfd 50 Volt Elctlt Capacitor	4 EA	C10,C11,C24,C25
35.	771.1610.1350	10 Mfd 50 Volt Electroltc Capacitor	2 EA	C1,C2
36.	771.1620.0350	20 Mfd 50 Vdc Electrolytc Capacitor	1 EA	C13
37.	771.1725.1350	250 Mfd 50 Volt Elctyc Capacitor	2 EA	C12,C4
38.	776.1310.0350	.01 MFD 50V Ceramic Disc Capacitor	11 EA	C7,C8,C14,C16-C23
39.	776.3301.0410	.01 Mfd 100 VDC Cpctr W/Rad Leads	3 EA	C3,C5,C9
40.	776.3350.1450	.05 Mfd 500 W Volt DC Disc Capacitr	1 EA	C6
41.	781.3205.6006	600 PIV 2.0 Amp FW Bridge Rectifier	3 EA	D1,D2,D7
42.	782.1040.05	1N4005 1A 600V Silicon Rectifier	8 EA	D3,D6,D8-D13
43.	782.1047.33	1N4733 5.1 Volt Zener Diode	1 EA	D5
44.	782.1047.37	1N4737 7.5 Volt 1 Watt 10% Zener	1 EA	D4
45.	782.2034.16	2N3416 Transistor NPN	1 EA	Q7
46.	782.2039.04	2N3904 Transistor NPN	1 EA	Q6
47.	782.2049.23	2N4923 Transistor	1 EA	Q4
48.	782.2051.95	2N5195 Transistor	1 EA	Q5
49.	786.1222.1402	3140A OP AMP 8 DIP Ceramic Hi Temp	2 EA	U7,U9
50.	786.1223.3240	324 Quad OP Amp 14 DIP Ceramic	1 EA	U1
51.	786.1223.7472	747A Op Amp 14 DIP Ceramic Hi Temp	1 EA	U2

. . . continued on next page

TABLE 5-37 Parts List for 6284.234.1009
MXR-350 Cnstnt Crnt Flmnt Cntrl Asm

	Part Number	Description	Quantity	Reference Designators
52.	786.2108.8152	7815 1.5A 15V Pos Regultr Ind/Plstc	1 EA	Q1
53.	786.2108.9082	7908 1.5A 8V Ngtv Rgltr Ind/Plstc	1 EA	Q3
54.	786.2108.9152	7915 1.5A 15V Neg Rgltr Ind/Plstc	1 EA	Q2
55.	786.3223.51	4051 CMOS Mux Ceramic Hi Temp	2 EA	U5,U6
56.	786.3223.66	4066 CMOS Switch Ceramic High Temp	2 EA	U3,U10
57.	786.3223.75	4075 CMOS Triple 3 In OR Ceramic	1 EA	U4
58.	786.3245.32	4532 CMOS Priority Encoder Ceramic	1 EA	U8
59.	786.9107.7012	H24B2 Darlington Opto-Coupler	2 EA	U11,U12

TABLE 5-37 **Parts List for 6284.234.1009**
MXR-350 Cnstnt Crnt Flmnt Cntrl Asm

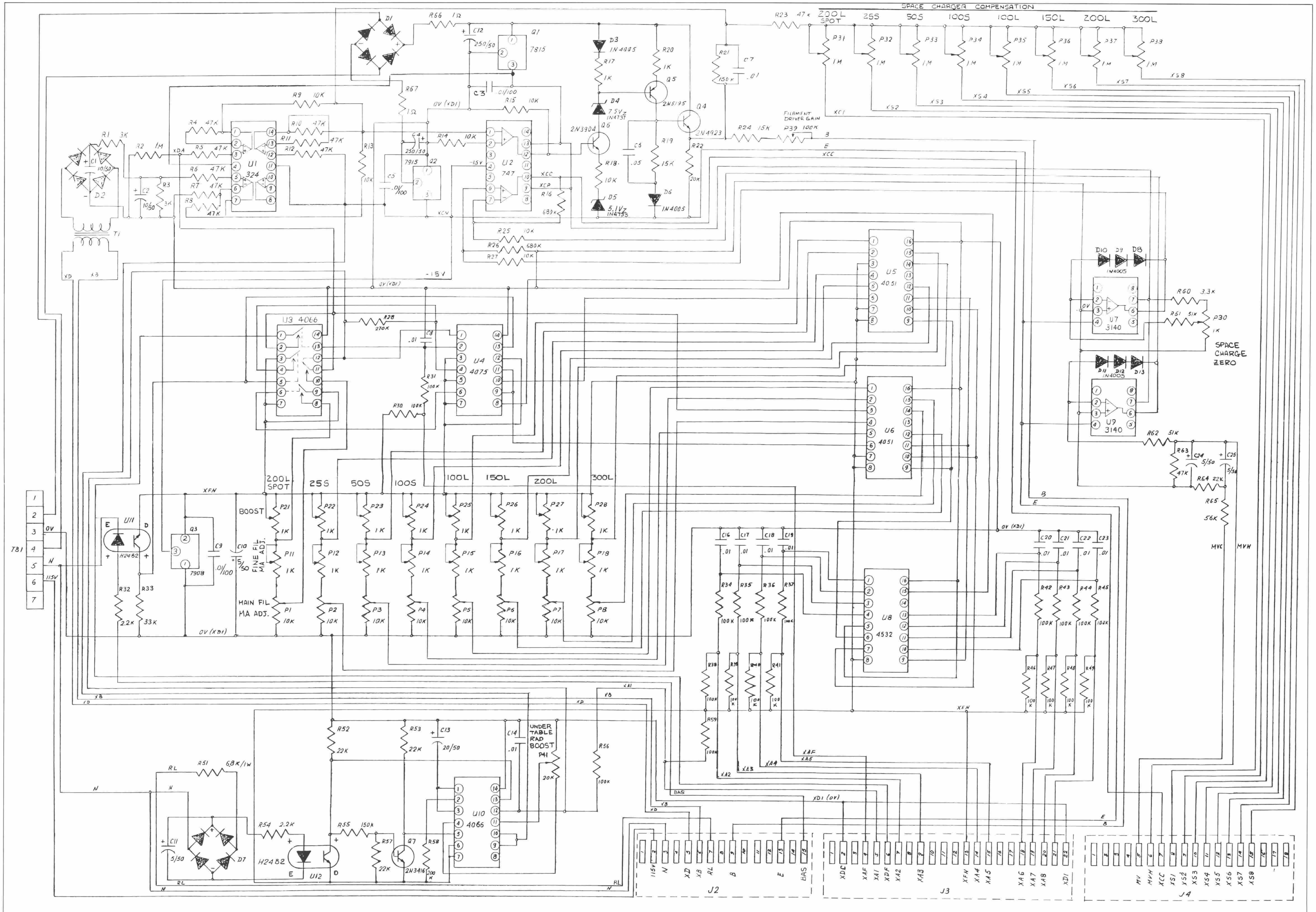
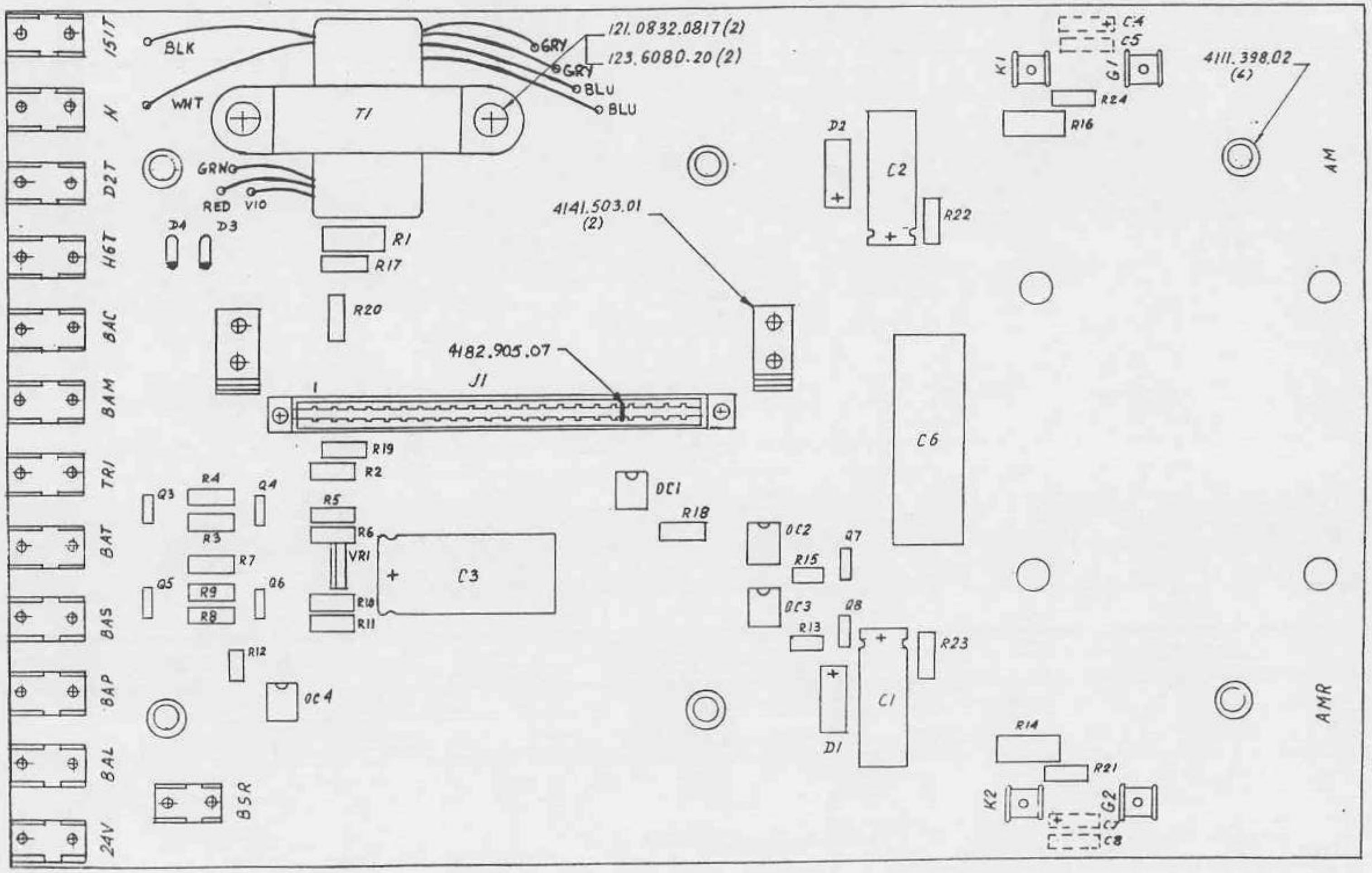

SPACE CHARGE COMPENSATION
200L SPOT
25S
50S
100S
100L
150L
200L
300L
R23 47K
P31 1M
P32 1M
P33 1M
P34 1M
P35 1M
P36 1M
P37 1M
P38 1M
XC1
XS2
XS3
XS4
XS5
XS6
XS7
XS8
D1
R66 1Ω
C12 250/50
Q1 7815
C3 .01/100
D3 1N4005
R17 1K
D4 7.5Vz 1N4737
D5 5.1Vz 1N4733
D6 1N4005
Q6 2N3904
R18 10K
R20 1K
Q5 2N5195
Q4 2N4923
R19 15K
R22 20K
C6 .05
R21 150K
C7 .01
FILAMENT DRIVER GAIN
R24 15K
P39 100K
B
E
XCC
R9 10K
R67 1Ω
0V (XD1)
R15 10K
R4 47K
R5 47K
R6 47K
R7 47K
R8 47K
R10 47K
R11 47K
R12 47K
U1 324
R13 10K
C4 250/50
Q2 7915
C5 .01/100
R14 10K
U2 747
-15V
XCC
XCP
R16 680K
XCV
R25 10K
R26 680K
R27 10K
R1 3K
R2 1M
XDA
C1 10/50
D2
C2 10/50
R3 3K
T1
XD
XB
-15V
0V (XD1)
U3 4066
R28 270K
C8 .01
U4 4075
R31 100K
R30 100K
U5 4051
U6 4051
U8 4532
D10
D9
D8
1N4005
U7 3140
R60 3.3K
R61 51K
P30 1K
SPACE CHARGE ZERO
D11
D12
D13
1N4005
U9 3140
R62 51K
R63 47K
C24 5/50
C25 5/50
R64 22K
R65 56K
MVC
MVH
XFN
BOOST
200L SPOT
25S
50S
100S
100L
150L
200L
300L
P21 1K
P22 1K
P23 1K
P24 1K
P25 1K
P26 1K
P27 1K
P28 1K
FINE FIL MA ADJ.
P11 1K
P12 1K
P13 1K
P14 1K
P15 1K
P16 1K
P17 1K
P18 1K
MAIN FIL MA ADJ.
P1 10K
P2 10K
P3 10K
P4 10K
P5 10K
P6 10K
P7 10K
P8 10K
0V (XD1)
781
1
2
3
4
5
6
7
0V
N
115V
U11 H2482
E
D
Q3 7908
C9 .01/100
C10 5/50
R32 2.2K
R33 33K
C16 .01
C17 .01
C18 .01
C19 .01
R34 100K
R35 100K
R36 100K
R37 100K
R38 100K
R39 100K
R40 100K
R41 100K
R59 100K
C20 .01
C21 .01
C22 .01
C23 .01
R42 100K
R43 100K
R44 100K
R45 100K
R46 100K
R47 100K
R48 100K
R49 100K
0V (XD1)
XA1
XB
XFN
XA2
XA3
XA4
XAF
XA5
BAS
XD1 (0V)
R52 22K
R53 22K
C13 20/50
C14 .01
UNDER TABLE RAD BOOST
P41 20K
R56 100K
U10 4066
RL
R51 68K/1W
N
C11 5/50
D7
R54 2.2K
H2482
U12
R55 150K
R57 22K
Q7 2N3416
R58 200K
J2
115V
N
XD
XB
RL
B
E
BAS
J3
XDC
XAF
XA1
XDF
XA2
XA3
XFN
XA4
XA5
XA6
XA7
XA8
XD1
J4
MV
MVH
XCC
XS1
XS2
XS3
XS4
XS5
XS6
XS7
XS8

FIGURE 5-66 SCHEMATIC FOR 6284.234.1009


151T
N
D2T
H6T
BAC
BAM
TRI
BAT
BAS
BAP
BAL
24V
BSR
BLK
WNT
GRN
RED
VIO
D4
D3
T1
GRY
GRY
BLU
BLU
121.0832.0817(2)
123.6080.20(2)
4141.503.01
(2)
4182.905.07
J1
1
R1
R17
R20
R19
R2
R4
R3
Q3
Q4
R5
R6
VR1
R7
Q5
Q6
R9
R8
R10
R11
R12
OC4
C3
OC1
R18
OC2
OC3
R15
R13
Q7
Q8
D1
C1
R23
D2
C2
R22
C6
K1
G1
C4
C5
R24
R16
4111.398.02
(4)
AM
AMR
R14
R21
K2
G2
C7
C8

MXR-350 SCR CONTACTOR-TIMER INTERFACE

FIGURE 5-67 LAYOUT FOR 6284.234.11

DIETZGEN NO. 199M AGEPROOF NO. 216.12

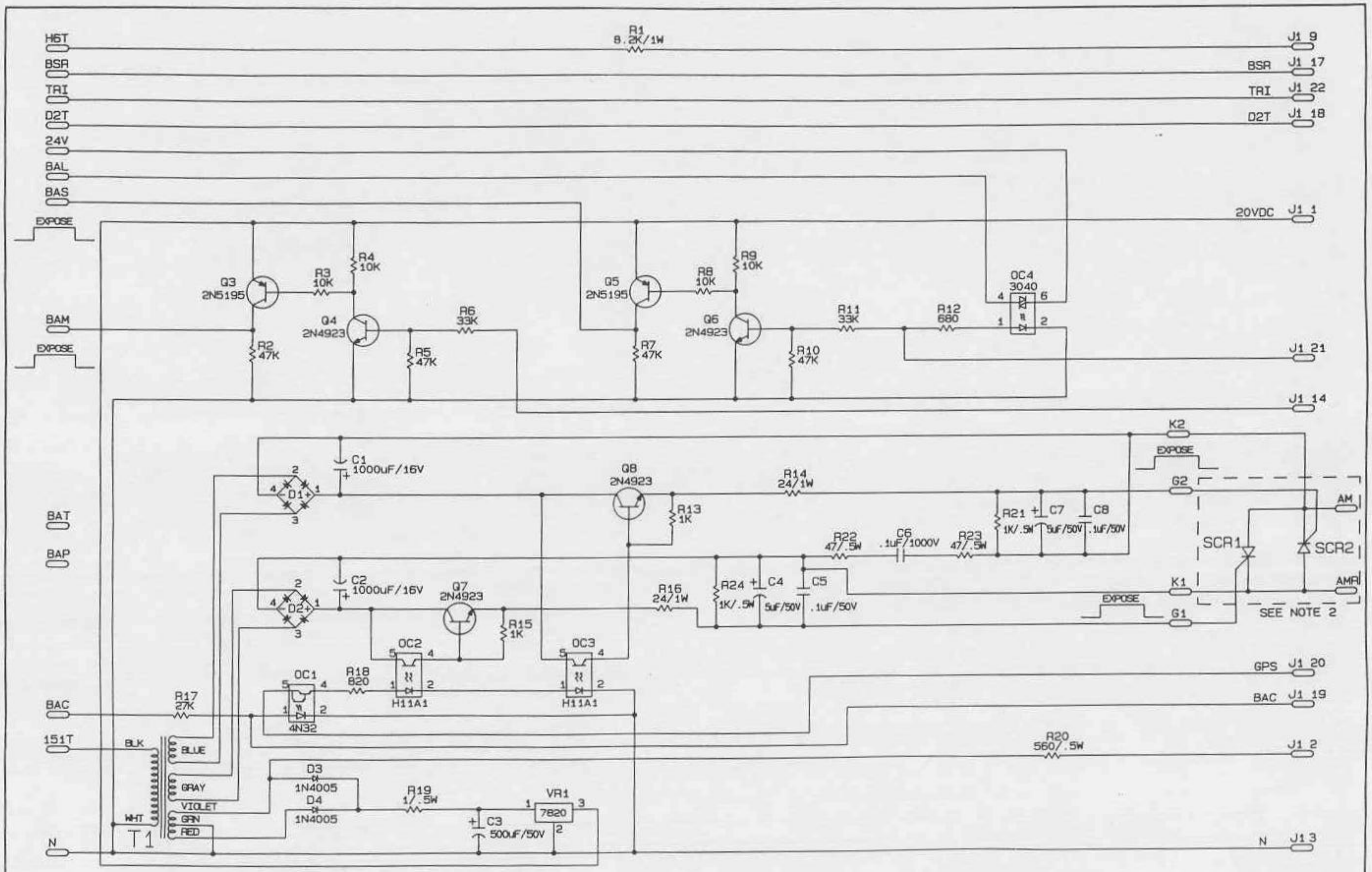
	Part Number	Description	Quantity	Reference Designators
1.	121.0832.0817	8-32 X 1/2 Round Steel Philps Screw	2 EA	
2.	123.6080.20	#8 Internal Tooth Steel Lockwasher	2 EA	
3.	129.5120.6511	1/8 X 3/16 Brass Eyelet	34 EA	
4.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
5.	4111.398.02	Etched Panel Mounting Bushing (3/4)	6 EA	
6.	4118.122.02	8-32 X 7/16 Fh A Rivnut	2 EA	
7.	4141.503.01	Impulse Timer Support Bracket	2 EA	
8.	4182.132.12	4-Way Tab Terminal	13 EA	
9.	4182.222.01	Double Tab Terminal	4 EA	
10.	4182.905.07	PC Connector Intercontact Key Plug	1 EA	
11.	4182.905.08	22 Pt 2-Side Brd/Brd Connector	1 EA	
12.	4186.503.07	Impulse Timer SCR Transformer	1 EA	T1
13.	4284.234.11	MXR-350 SCR Contactor/Tmr PC Blank	1 EA	
14.	751.1256.4680	680 Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R12
15.	751.1256.4820	820 Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R18
16.	751.1256.51	1.0K 1/4 Watt 5% Carbon Resistor	2 EA	R13,15
17.	751.1256.61	10K Ohm 1/4 Watt 5% Carbon Resistor	4 EA	R3,4,8,9
18.	751.1256.6270	27K Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R17
19.	751.1256.6330	33K Ohm 1/4 Watt 5% Carbon Resistor	2 EA	R6,11
20.	751.1256.6470	47K Ohm 1/4 Watt 5% Carbon Resistor	4 EA	R2,5,7,10
21.	751.1506.21	1 Ohm 1/2Watt 5% Carbon Resistor	1 EA	R19
22.	751.1506.3470	47R 1/2 Watt 5% Carbon Resistor	2 EA	R22,23
23.	751.1506.4560	560R 1/2 Watt 5% Carbon Resistor	1 EA	R20
24.	751.1506.51	1K 1/2 Watt 5% Carbon Resistor	2 EA	R21,24
25.	751.2106.3240	24R 1 Watt 5% Carbon Resistor	2 EA	R14,16
26.	751.2106.5820	8.2K 1 Watt 5% Carbon Resistor	1 EA	R1

. . . continued on next page

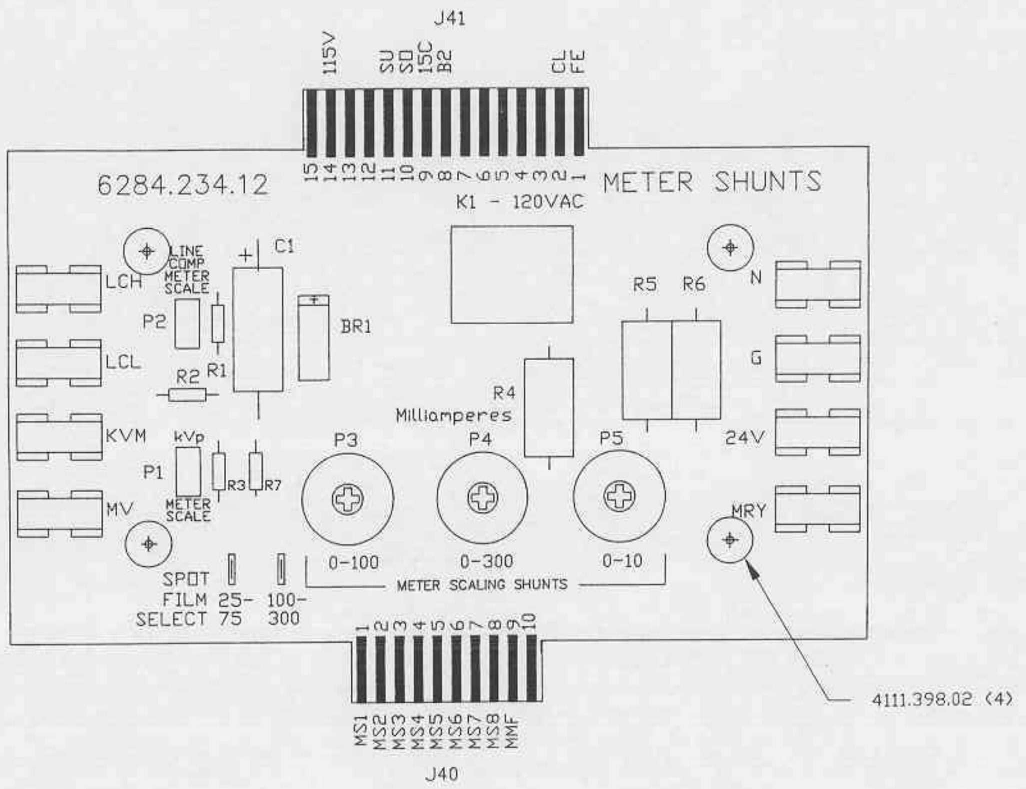
TABLE 5-38 Parts List for 6284.234.11
MXR-350 SCR Contactor-Timer Intrfc

	Part Number	Description	Quantity	Reference Designators
27.	771.1550.2350	5 Mfd 50 Volt Elctlt Capacitor	2 EA	C4,7
28.	771.1750.1350	500 Mfd 50 Volt Elctyc Capacitor	1 EA	C3
29.	771.1810.1315	1000 Mfd 15 Volt Elctyc Capacitor	2 EA	C1,2
30.	774.1410.3510	.1 Mfd 1000 Vdcw Capacitor	1 EA	C6
31.	776.1410.1350	.1 Mfd 50 Volt Disc Capacitor	2 EA	C5,8
32.	781.3205.6006	600 PIV 2.0 Amp FW Bridge Rectifier	2 EA	D1,2
33.	782.1040.05	1N4005 1A 600V Silicon Rectifier	2 EA	D3,4
34.	782.2049.23	2N4923 Transistor	4 EA	Q4,6,7,8
35.	782.2051.95	2N5195 Transistor	2 EA	Q3,5
36.	786.2108.8202	1A 20V Pos Voltage Regulator	1 EA	VR1
37.	786.9109.5159	3040 Opto Cpld Triac Drvr 400V ZVS	1 EA	OC4
38.	786.9109.6150	H11A1 Led/Trstr Optocplr .5 Gain	2 EA	OC2,3
39.	786.9109.7127	4N32 LED Darlington Optocoupler	1 EA	OC1

TABLE 5-38 Parts List for 6284.234.11
MXR-350 SCR Contactor-Timer Intrfc


HST
BSR
TRI
D2T
24V
BAL
BAS
EXPOSE
BAM
EXPOSE
BAT
BAP
BAC
151T
N
R1
8.2K/1W
J1 9
BSR J1 17
TRI J1 22
D2T J1 18
20VDC J1 1
J1 21
J1 14
Q3
2N5195
R2
47K
R3
10K
R4
10K
Q4
2N4923
R5
47K
R6
33K
Q5
2N5195
R7
47K
R8
10K
R9
10K
Q6
2N4923
R10
47K
R11
33K
R12
680
OC4
3040
C1
1000uF/16V
D1
Q8
2N4923
R13
1K
R14
24/1W
K2
EXPOSE
G2
AM
SCR1
SCR2
AMR
K1
EXPOSE
G1
SEE NOTE 2
R21
1K/.5W
C7
5uF/50V
C8
.1uF/50V
R22
47/.5W
C6
.1uF/1000V
R23
47/.5W
C2
1000uF/16V
D2
Q7
2N4923
R15
1K
R16
24/1W
R24
1K/.5W
C4
5uF/50V
C5
.1uF/50V
OC1
4N32
R18
820
OC2
H11A1
OC3
H11A1
R17
27K
GPS J1 20
BAC J1 19
R20
560/.5W
J1 2
T1
BLK
BLUE
GRAY
VIOLET
GRN
RED
WHT
D3
1N4005
D4
1N4005
R19
1/.5W
C3
500uF/50V
VR1
7820
N J1 3

MXR-350 SCR CONTACTOR-TIMER INTERFACE
FIGURE 5-68 SCHEMATIC FOR 6284.234.11

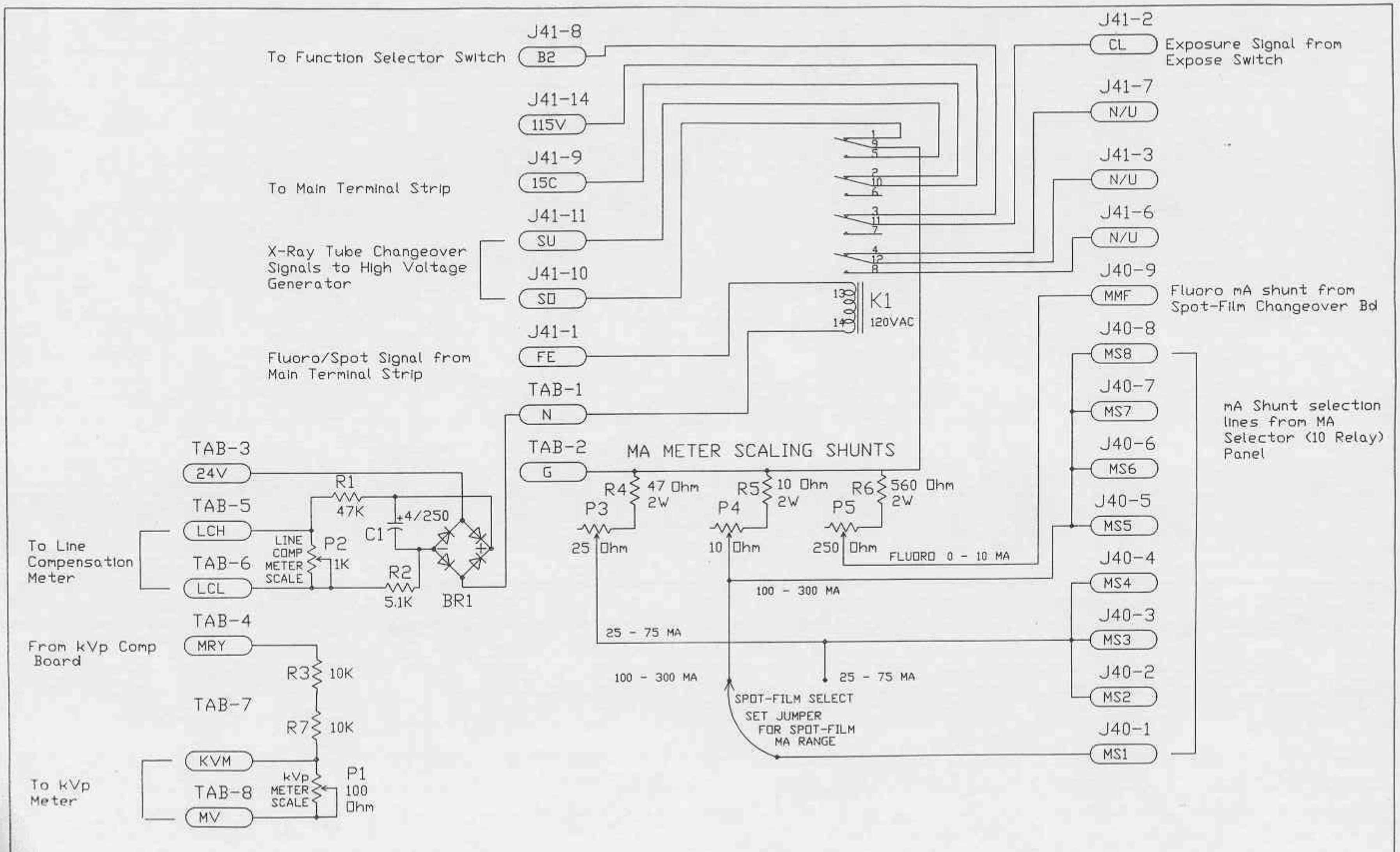

J41
115V
SU
SD
15C
B2
CL
FE
15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
6284.234.12
METER SHUNTS
K1 - 120VAC
LINE COMP METER SCALE
C1
LCH
P2
R1
BR1
LCL
R2
R5
R6
N
G
R4
Milliamperes
KVM
kVp
P1
R3
R7
P3
P4
P5
24V
MV
METER SCALE
MRY
SPOT FILM SELECT
25-75
100-300
0-100
0-300
0-10
METER SCALING SHUNTS
1 2 3 4 5 6 7 8 9 10
MS1
MS2
MS3
MS4
MS5
MS6
MS7
MS8
MMF
J40
4111.398.02 (4)

MXR-350 mA-kVp-LINE METER SHUNT ASM

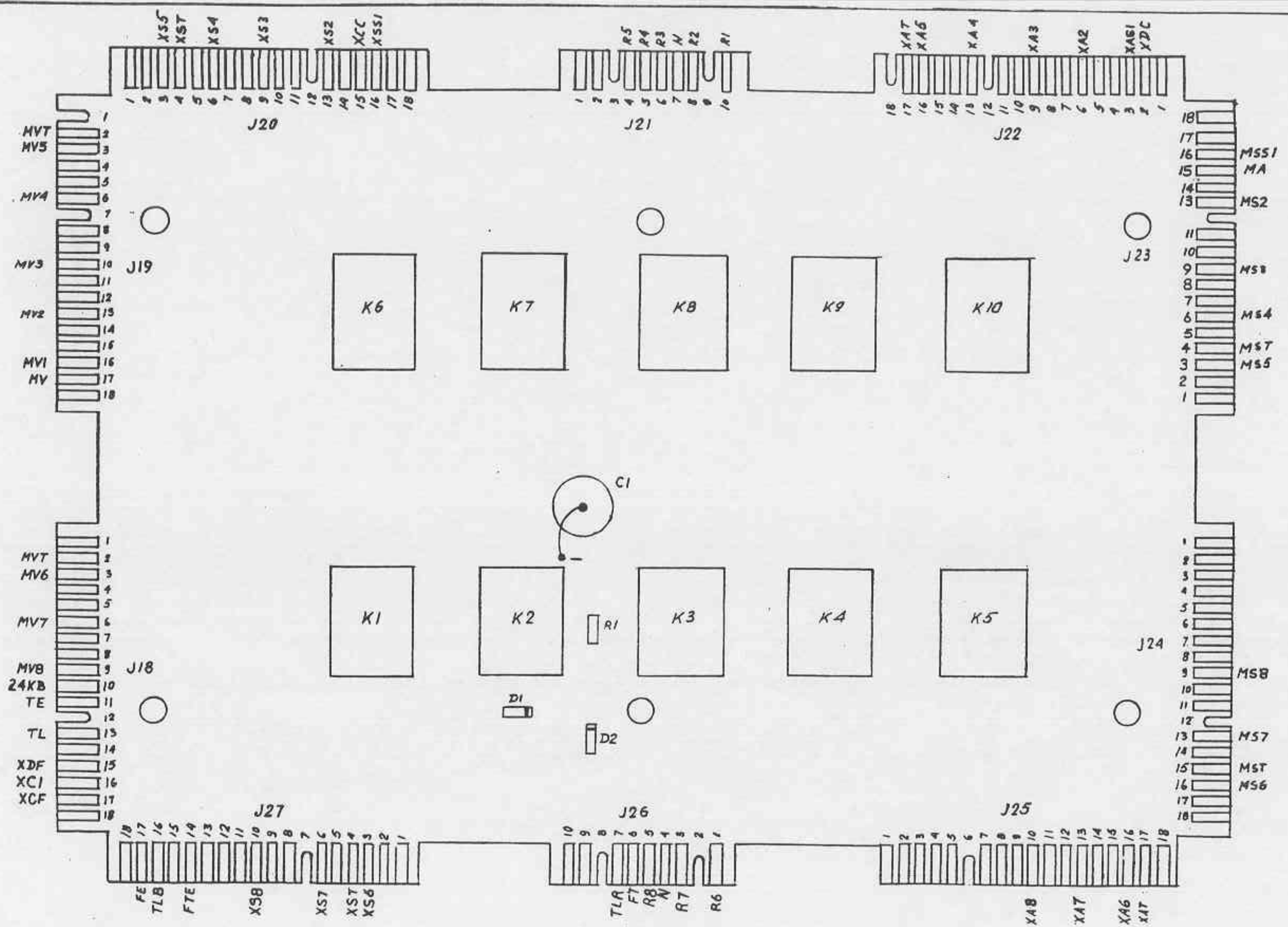
FIGURE 5-69 LAYOUT FOR 6284.234.12

	Part Number	Description	Quantity	Reference Designators
1.	129.5120.6511	1/8 X 3/16 Brass Eyelet	16 EA	
2.	135.5401.	GE SR900 Silicone Conformal Coating	.01 GL	
3.	4111.398.02	Etched Panel Mounting Bushing (3/4)	4 EA	
4.	4182.011.01	.187 X.020T PC Board Disconnect Tab	2 EA	
5.	4182.132.12	4-Way Tab Terminal	8 EA	
6.	4284.234.12	MA-KVP-Line Meter Shunt PCB Blank	1 EA	
7.	714.4371.1221	4PDT 120 Volt AC Mini Relay	1 EA	K1
8.	714.9001.	4PDT Mini Relay Pc Socket	1 EA	
9.	714.9002.	Relay Hold-Down Spring	1 EA	
10.	733.2207.0151	22 Ga 1 Con 300v Green Hookup Wire	.20 FT	
11.	751.1256.5510	5.1K 1/4 Watt 5% Carbon Resistor	1 EA	R2
12.	751.1256.6470	47K Ohm 1/4 Watt 5% Carbon Resistor	1 EA	R1
13.	751.2206.31	10 R 2 Watt 5% Carbon Resistor	1 EA	R5
14.	751.2206.3470	47 R 2 Watt 5% Carbon Resistor	1 EA	R4
15.	751.2206.4560	560R 2 Watt 5% Carbon Resistor	1 EA	R6
16.	754.1504.1020	1/2W 100R 25T Vert Adj 3/8 Sq Pot	1 EA	P1
17.	754.1505.1011	1/2W 1K 20T Vert Adj 3/8 Sq Potmtr	1 EA	P2
18.	755.2203.1001	10R 2 Watt WW Low T/C Potentiometer	1 EA	P4
19.	755.2203.2501	25 Ohm 2 Watt WW Potentiometer	1 EA	P3
20.	755.2204.2501	250R 2 Watt WW Low TC Potentiometer	1 EA	P5
21.	757.1255.61	10K 1/4W 2% Temp. Cmpnstd Resistor	2 EA	R3,7
22.	762.4500.	.187 Faston Fml Trmnl Continuous Rl	1 EA	
23.	771.1540.1425	4 Mfd 250 Volt Dc Elctyc Capacitor	1 EA	C1
24.	781.3205.6006	600 PIV 2.0 Amp FW Bridge Rectifier	1 EA	BR1

TABLE 5-39 Parts List for 6284.234.12
MXR-350 mA-KVP Line Meter Shunt Asm


J41-8
B2
To Function Selector Switch
J41-14
115V
J41-9
15C
To Main Terminal Strip
J41-11
SU
X-Ray Tube Changeover Signals to High Voltage Generator
J41-10
SD
J41-1
FE
Fluoro/Spot Signal from Main Terminal Strip
TAB-1
N
TAB-2
G
MA METER SCALING SHUNTS
K1
120VAC
1
9
5
2
10
6
3
11
7
4
12
8
13
14
J41-2
CL
Exposure Signal from Expose Switch
J41-7
N/U
J41-3
N/U
J41-6
N/U
J40-9
MMF
Fluoro mA shunt from Spot-Film Changeover Bd
J40-8
MS8
J40-7
MS7
J40-6
MS6
J40-5
MS5
J40-4
MS4
J40-3
MS3
J40-2
MS2
J40-1
MS1
mA Shunt selection lines from MA Selector (10 Relay) Panel
R4
47 Ohm
2W
R5
10 Ohm
2W
R6
560 Ohm
2W
P3
25 Ohm
P4
10 Ohm
P5
250 Ohm
FLUORO 0 - 10 MA
100 - 300 MA
25 - 75 MA
100 - 300 MA
25 - 75 MA
SPOT-FILM SELECT
SET JUMPER FOR SPOT-FILM MA RANGE
TAB-3
24V
TAB-5
LCH
TAB-6
LCL
To Line Compensation Meter
R1
47K
C1
+4/250
LINE COMP METER SCALE
P2
1K
R2
5.1K
BR1
TAB-4
MRY
From kVp Comp Board
R3
10K
TAB-7
R7
10K
KVM
TAB-8
MV
To kVp Meter
kVp METER SCALE
P1
100 Ohm

MXR-350 mA-kVp-LINE METER SHUNT ASM
FIGURE 5-70 SCHEMATIC FOR 6284.234.12



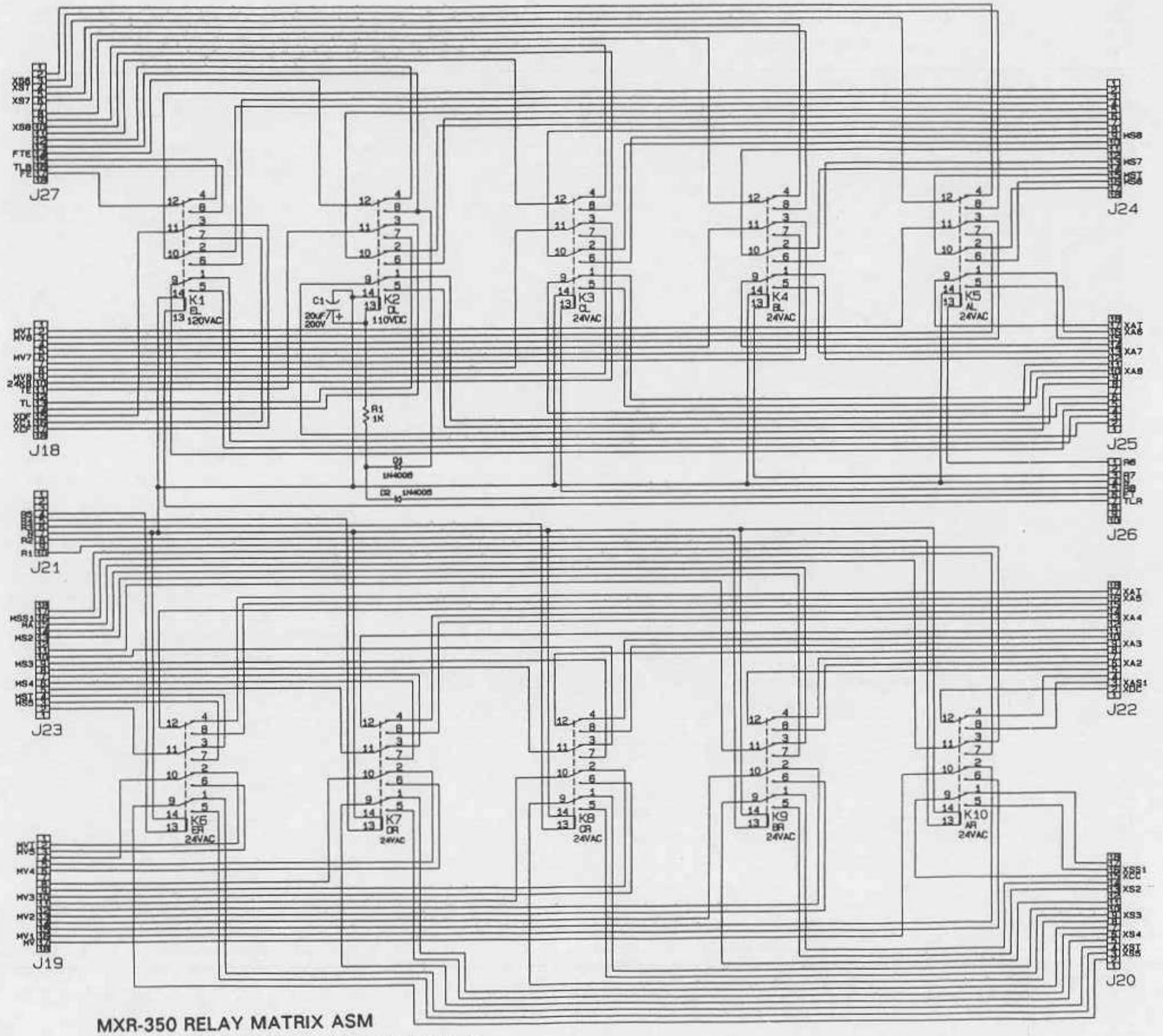
J18
J19
J20
J21
J22
J23
J24
J25
J26
J27
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
C1
R1
D1
D2
MVT
MV5
MV4
MV3
MV2
MV1
MV
MVT
MV6
MV7
MV8
24KB
TE
TL
XDF
XCI
XCF
XS5
XST
XS4
XS3
XS2
XCC
XSS1
R5
R4
R3
N
R2
R1
XAT
XA6
XA4
XA3
XA2
XA61
XDC
MSS1
MA
MS2
MS8
MS4
MST
MS5
MS8
MS7
MST
MS6
FE
TLB
FTE
XS8
XS7
XST
XS6
TLR
FT
R8
N
R7
R6
XA8
XAT
XA6
XAT

MXR-350 RELAY MATRIX ASM

FIGURE 5-71 LAYOUT FOR 6584.234.01

	Part Number	Description	Quantity		Reference Designators
1.	123.2606.1031	#6 5/16 OD White Flat Nylon Washer	1	EA	
2.	135.3416.01	#16 Teflon Insulating Tubing	.20	FT	
3.	135.5401.	GE SR900 Silicone Conformal Coating	.02	GL	
4.	4111.398.02	Etched Panel Mounting Bushing (3/4)	6	EA	
5.	4584.234.01	MXR-350 Relay Matrix PC Blank	1	EA	
6.	714.4355.1211	4PDT 24 Volt AC Mini Power Relay	8	EA	K3-10
7.	714.4371.1221	4PDT 120 Volt AC Mini Relay	1	EA	K1
8.	714.4687.1222	4PDT 110 Volt DC Mini Power Relay	1	EA	K2
9.	714.9001.	4PDT Mini Relay Pc Socket	10	EA	
10.	714.9002.	Relay Hold-Down Spring	10	EA	
11.	738.0320.	20 Awg Solid Tinned Copper Wire	.20	FT	
12.	751.1256.51	1.0K 1/4 Watt 5% Carbon Resistor	1	EA	R1
13.	771.1620.1425	20 Mfd 250 Volt Electyc Capacitor	1	EA	C1
14.	782.1040.05	1N4005 1A 600V Silicon Rectifier	2	EA	D1,2

TABLE 5-40 Parts List for 6584.234.01
MXR-350 Relay Matrix PCB Asm


J27
XS7
XS8
FTE
J18
HV7
TL
J21
R2
R1
J23
HSS1
HS2
HS3
HS4
J19
HV4
HV3
HV2
K1
BL
120VAC
C1
20uF
200V
K2
DL
110VDC
R1
1K
D1
1N4006
D2
1N4006
K3
CL
24VAC
K4
BL
24VAC
K5
AL
24VAC
K6
ER
24VAC
K7
DR
24VAC
K8
CR
24VAC
K9
BR
24VAC
K10
AR
24VAC
HS8
HS7
J24
XA7
XA8
J25
R6
R7
TLR
J26
XA4
XA3
XA2
XAS1
J22
XSS1
XS2
XS3
XS4
J20

MXR-350 RELAY MATRIX ASM

FIGURE 5-72 SCHEMATIC FOR 6584.234.01

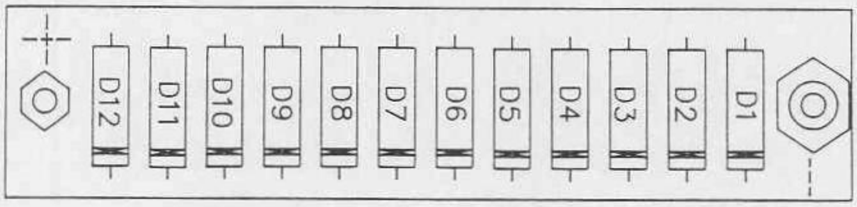
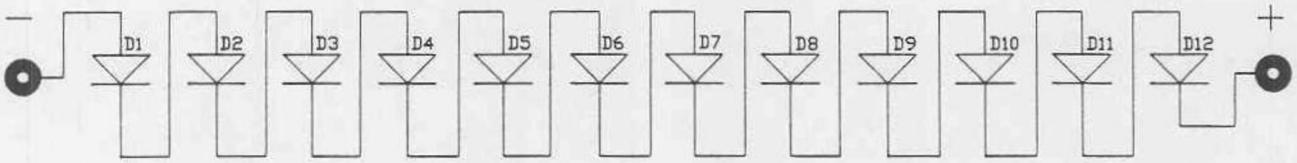

D12
D11
D10
D9
D8
D7
D6
D5
D4
D3
D2
D1

FIGURE 5-73 75 KVP PLUG-IN RECTIFIER ASM **5184.323.02**

	Part Number	Description	Quantity	Reference Designators
1.	123.6060.20	#6 Internal Tooth Steel Lockwasher	1 EA	
2.	123.6140.20	1/4 Internal Tooth Steel Lockwasher	1 EA	
3.	4182.323.01	Uninsulated Banana Plug 3/8" Stud	1 EA	
4.	4182.323.02	Uninsulated Banana Standard Jack	1 EA	
5.	4184.323.02	75 KVP Plug In Rectifier Blank	1 EA	
6.	781.2226.7004	.22 Amp 7 KV Silicon Rectifier	12 EA	D1-D12

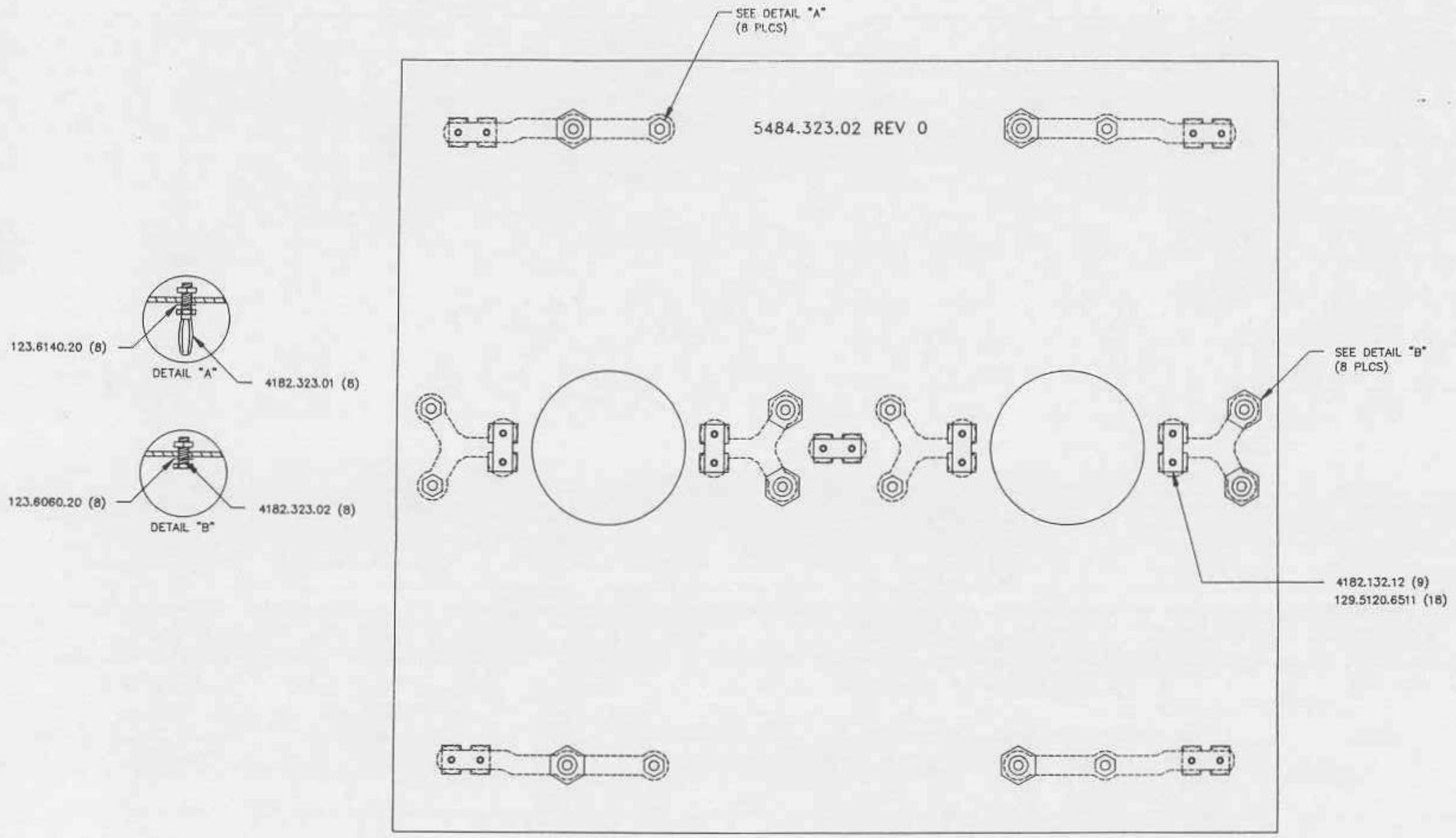
TABLE 5-41 Parts List for 5184.323.02
75 kVp Plug In Rectifier Assembly



—
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
+

75 KVP PLUG-IN RECTIFIER ASM

FIGURE 5-74 SCHEMATIC FOR 5184.323.02

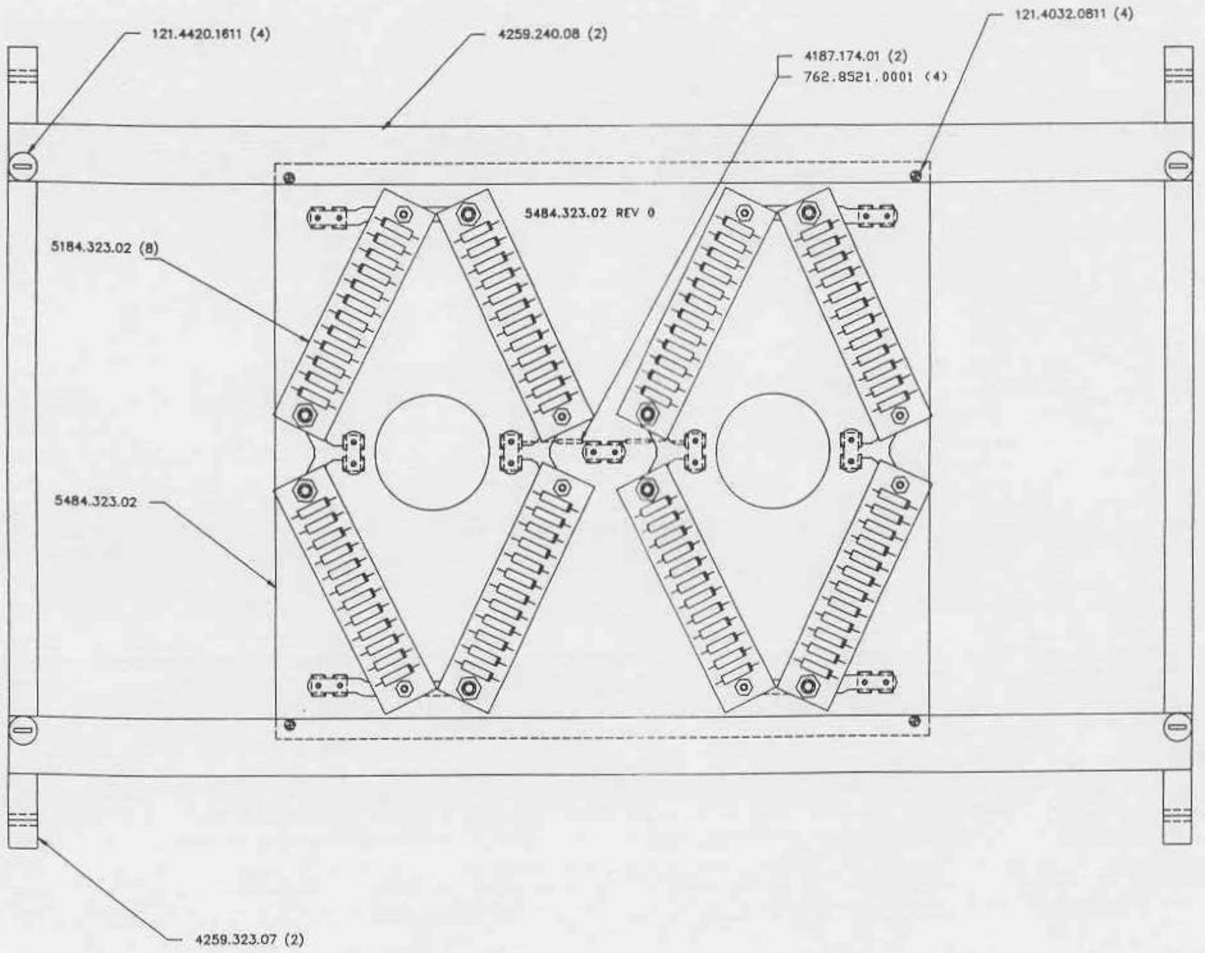


SEE DETAIL "A"
(8 PLCS)
5484.323.02 REV 0
123.6140.20 (8)
DETAIL "A"
4182.323.01 (8)
123.6060.20 (8)
DETAIL "B"
4182.323.02 (8)
SEE DETAIL "B"
(8 PLCS)
4182.132.12 (9)
129.5120.6511 (18)

PLUG-IN HV DIODE BRIDGE ASM
FIGURE 5-75 LAYOUT FOR 5484.323.02

	Part Number	Description	Quantity	Reference Designators
1.	123.6060.20	#6 Internal Tooth Steel Lockwasher	8 EA	
2.	123.6140.20	1/4 Internal Tooth Steel Lockwasher	8 EA	
3.	129.5120.6511	1/8 X 3/16 Brass Eyelet	18 EA	
4.	4182.132.12	4-Way Tab Terminal	9 EA	
5.	4182.323.01	Uninsulated Banana Plug 3/8" Stud	8 EA	
6.	4182.323.02	Uninsulated Banana Standard Jack	8 EA	
7.	4484.323.02	Plug-in HV Diode Bridge PCB	1 EA	

TABLE 5-42 Parts List for 5484.323.02
Plug-in HV Diode Bridge Asm

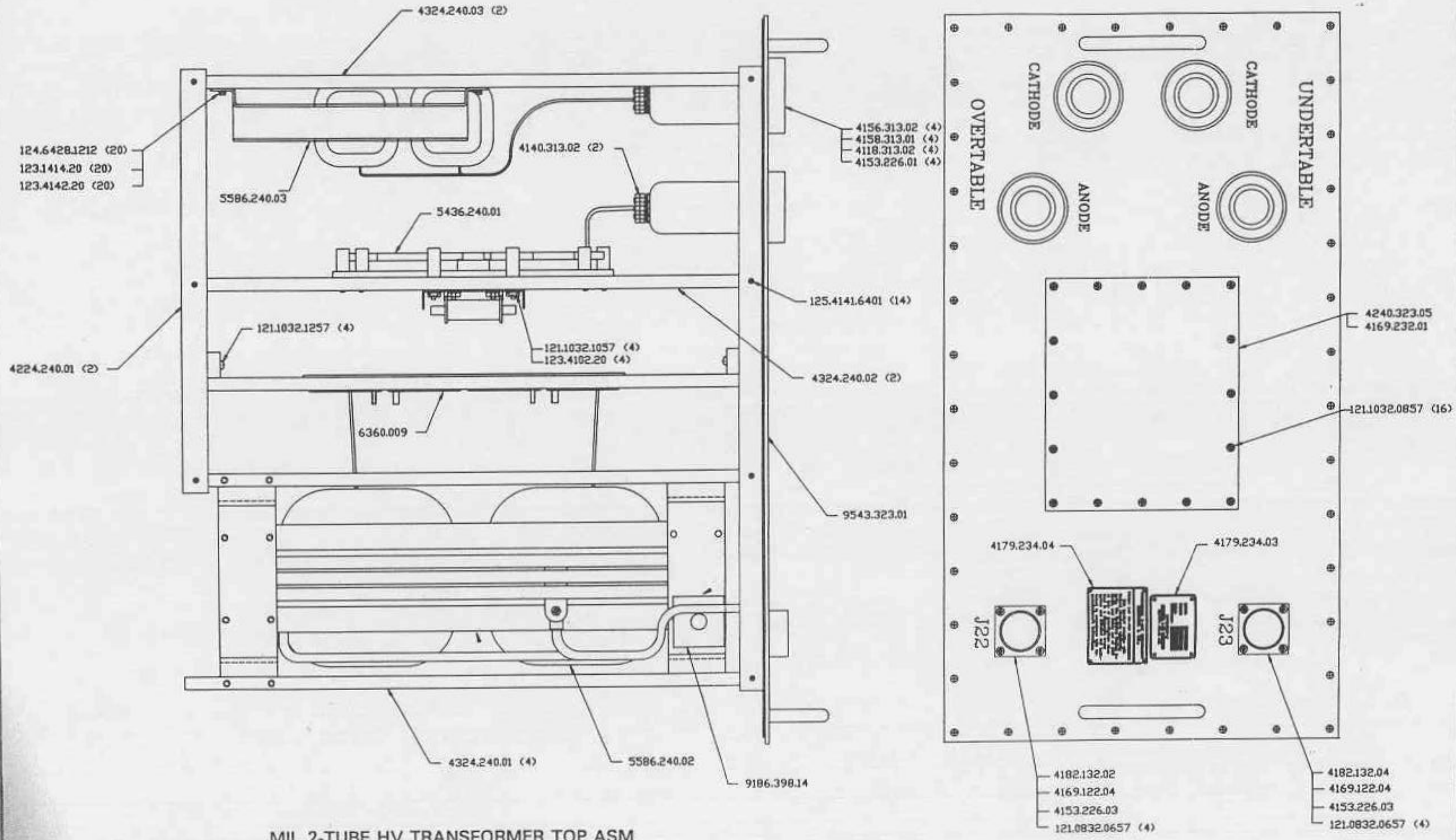

121.4420.1611 (4)
4259.240.08 (2)
4187.174.01 (2)
762.8521.0001 (4)
121.4032.0811 (4)
5484.323.02 REV 0
5184.323.02 (8)
5484.323.02
4259.323.07 (2)

150 KV PLUG-IN RECTIFIER ASM

FIGURE 5-76 LAYOUT FOR 6360.009

	Part Number	Description	Quantity	Reference Designators
1.	121.4032.0811	10-32 X 1/2 Slotted Nylon Screw	4 EA	
2.	121.4420.1611	1/4-20 X 1 Nylon Sltd Rd Head Screw	4 EA	
3.	4187.174.01	1/4 Watt 60 Volt DC Thyrite	2 EA	
4.	4259.240.08	150Kv Rectifier Asm Side Support	2 EA	
5.	4259.323.07	150kV Rectifier Asm End Supprt -Mil	2 EA	
6.	5184.323.02	75 kVp Plug In Rectifier Assembly	8 EA	
7.	5484.323.02	Plug-in HV Diode Bridge Asm	1 EA	
8.	762.8521.0001	.250 #18 Female Cont Strip Tab Term	4 EA	

TABLE 5-43 Parts List for 6360.009.
150 kV Plug-in Rectifier Asm


4324.240.03 (2)
124.6428.1212 (20)
123.1414.20 (20)
123.4142.20 (20)
5586.240.03
4140.313.02 (2)
5436.240.01
4156.313.02 (4)
4158.313.01 (4)
4118.313.02 (4)
4153.226.01 (4)
125.4141.6401 (14)
121.1032.1257 (4)
121.1032.1057 (4)
123.4102.20 (4)
4224.240.01 (2)
4324.240.02 (2)
6360.009
9543.323.01
4324.240.01 (4)
5586.240.02
9186.398.14
OVERTABLE
CATHODE
ANODE
UNDERTABLE
CATHODE
ANODE
4240.323.05
4169.232.01
121.1032.0857 (16)
4179.234.04
4179.234.03
J22
J23
4182.132.02
4169.122.04
4153.226.03
121.0832.0657 (4)
4182.132.04
4169.122.04
4153.226.03
121.0832.0657 (4)

MIL 2-TUBE HV TRANSFORMER TOP ASM

FIGURE 5-77 ASSEMBLY DRAWING FOR 5786.323.03

	Part Number	Description	Quantity	Reference Designators
1.	121.0832.0657	8-32 X 3/8 Pan Steel Phillips Screw	8 EA	
2.	121.1032.0857	10-32 X 1/2 Pan Steel Philips Screw	16 EA	
3.	121.1032.1057	10-32 X 5/8 Pan Steel Philips Screw	4 EA	
4.	121.1032.1257	10-32 X 3/4 Pan Steel Philips Screw	4 EA	
5.	123.1414.20	17/64I 1/20d 1/16T Stl Elect.Washer	20 EA	
6.	123.4102.20	#10 Medium Pattern Split Lockwasher	4 EA	
7.	123.4142.20	1/4 Medium Pattern Split Lockwasher	20 EA	
8.	123.6140.20	1/4 Internal Tooth Steel Lockwasher	20 EA	
9.	124.6428.1212	1/4-28 X 3/4 Hex Head Cap Screw	20 EA	
10.	125.4141.6401	7/32 Od X 1 Long .040 Thick Rollpin	14 EA	
11.	4118.313.02	Federal Standard Insulator Nut	4 EA	
12.	4140.313.02	Anode Shorting Plate	2 EA	
13.	4153.226.01	2-3/4" OD Plug Cover	4 EA	
14.	4153.226.03	1-3/4 Plastic Connector Cover	2 EA	
15.	4156.313.02	Federal Standard Cable Receptacle	4 EA	
16.	4158.313.01	Federal Terminal Insulator Gasket	4 EA	
17.	4169.122.04	28 Bulkhead Connector Gasket	2 EA	
18.	4169.232.01	302 Transformer Port Gasket	1 EA	
19.	4179.234.03	MXR-350 Manufactured Label	1 EA	
20.	4179.234.04	MXR-350 Certification Label	1 EA	
21.	4182.112.09	12.10 X 1/4 Ring Terminal	7 EA	
22.	4182.122.08	12.10 X 10 Ring Terminal	1 EA	
23.	4182.132.02	3 Pin Male Receptacle	1 EA	
24.	4182.132.04	12 Prong Male Receptacle	1 EA	
25.	4224.240.01	Lower Core Support	2 EA	
26.	4240.323.05	Military Tank Window Cover	1 EA	

. . . continued on next page

TABLE 5-44 Parts List for 5786.323.03
Military 2-Tube HV Trnsfrmr Top Asm

	Part Number	Description	Quantity	Reference Designators
27.	4324.240.01	High Voltage Support	4 EA	
28.	4324.240.02	Rectifier Support Rod	2 EA	
29.	4324.240.03	Filament Support Rod	2 EA	
30.	5436.240.01	Wkfld 150Kv Hv 2Tb Changeovr Switch	1 EA	
31.	5586.240.02	350 Hv Transformer Assembly	1 EA	
32.	5586.240.03	Filament Transformer Assembly	1 EA	
33.	6360.009.	150 kV Plug-in Rectifier Asm	1 EA	
34.	9186.398.14	Unbalance Transformer Assembly	1 EA	
35.	9543.323.01	MXR-350 HV Trnsfrmr Tank Cover Asm	1 EA	

TABLE 5-44 Parts List for 5786.323.03
Military 2-Tube HV Trnsfrmr Top Asm

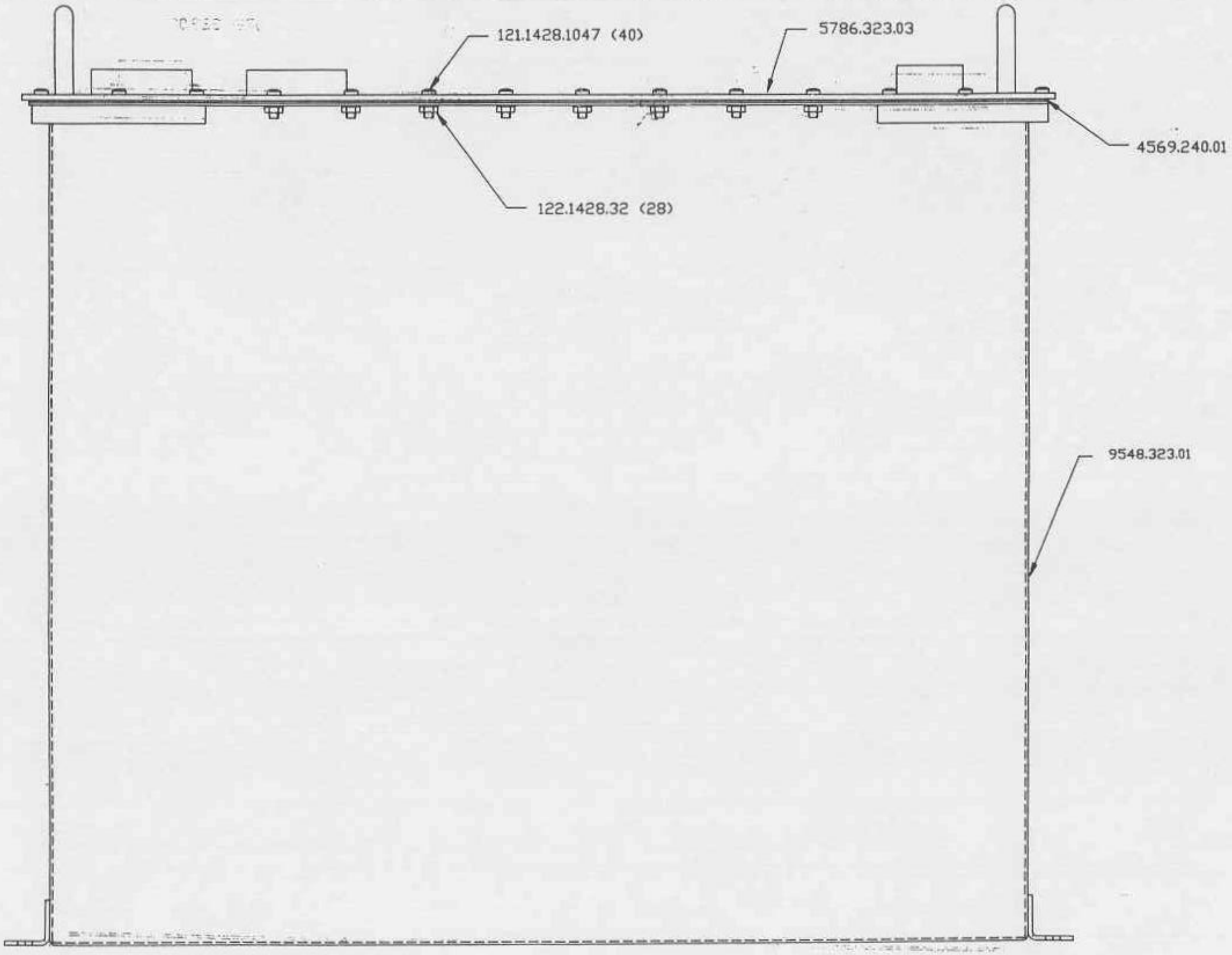

121.1428.1047 (40)
5786.323.03
4569.240.01
122.1428.32 (28)
9548.323.01

FIGURE 5-78 TRANSFORMER ASSEMBLY DRAWING

	Part Number	Description	Quantity	Reference Designators
1.	121.1428.1047	1/4-28 X 5/8 Filstr Stl Phlps Screw	40 EA	
2.	122.1428.32	1/4-28 Hex Steel Jam Nut Nkl Plt	28 EA	
3.	224.1055.	Diala AX Transformer Oil	34 GL	
4.	4569.240.01	Transformer Tank Gasket	1 EA	
5.	5196.323.01	MXR-350 H.V. Trnsfrmr Instlltn Kit	1 EA	
6.	5786.323.03	Military 2-Tube HV Trnsfrmr Top Asm	1 EA	
7.	9548.323.01	350 2T Transformer Tank Weldment	1 EA	

TABLE 5-45 Parts List for 6632.300.
300mA 150kV 2-Tube Trnsfrmr - Mil.